DOCUMENT RESUME

ED 253 398 SE 045 361

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TITLE 1982-83 Results of the NSTA Survey of the Needs of Elementary Teachers regarding the Teaching of Science.
INSTITUTION National Science Teachers Association, Washington, D.C.
PUB DATE 20 Jan 84
NOTE 208p.
PUB TYPE Reports - Research/Technical (143) -- Tests/Evaluation Instruments (160)

EDRS PRICE MF01/PC09 Plus Postage.
DESCRIPTORS Course Content; Elementary Education; *Elementary School Science; Elementary School Teachers; *Instructional Improvement; National Surveys; *Needs Assessment; Process Education; *Program Length; Science Course Improvement Projects; Science Curriculum; Science Education; *Science Instruction; Teacher Improvement; *Teaching Methods; Time Management
IDENTIFIERS Science Education Research

ABSTRACT

A survey was conducted to determine the needs of elementary teachers with respect to the teaching of science. Areas addressed in the survey included: biological, physical, and earth science topics taught at various grade levels; criteria used to select sequencing and content of the science curriculum; most common methods of instruction used in the teachers' science classroom; process-based national curriculum projects used in the last 2 years of science teaching; factors that would be most helpful in improving science instruction; areas that hamper science planning/instruction; time required by state guidelines per week; time required/suggested by school district per week; average time of science instruction per week; adequacy of science instruction in teachers' schools; and science program/curriculum in use. Each of these areas is discussed in terms of six demographic variables, namely: (1) grade levels; (2) years of experience in teaching; (3) size of school district; (4) region of the United States; (5) type of residential setting; and (6) college degree(s) held. Findings, among others, indicate that few teachers are using the process-oriented curricula developed during the 1960's and that instruction is fact- and concept-centered rather than process-oriented. Recommendations for in-service workshops are made based on these and other findings. (JN)

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1982-83 Results of the NSTA Survey of the Needs of Elementary Teachers Regarding the Teaching of Science

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January 20, 1984

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I. Introduction

A major goal of the National Science Teachers Association (NSTA) is the improvement of the teaching of science in all levels. In order to improve science teaching, the status of the quality of the teaching must be first documented. Then means must be taken to address the specific needs that teachers have to aid them in improving their science instruction.

The needs and the perceptions of elementary teachers with respect to their teaching science were obtained through a survey conducted by the Preschool/Elementary Committee of NSTA in the spring of 1983. This report discusses the results of this survey.

II. Rationale for the Survey

The quality and quantity of science taught in elementary schools is dependent on the capability and motivation of the elementary teacher (1). Most elementary teachers, however, do not feel qualified to teach science. In fact, in a survey sponsored by the National Science Foundation in 1977, only 22% of the teachers surveyed felt well qualified to teach science (2).

One approach to improving science instruction in all levels is to improve the quality of preservice instruction in the nation's colleges and universities. During 1981-82, representatives of four

NSTA committees, Preschool/Elementary, Middle/Junior High, Research, and Teacher Education, formed a steering committee to plan strategies to collect baseline data on current teacher preparation programs. As part of the data collecting task, the Preschool/Elementary Committee surveyed approximately 100 practicing elementary teachers in 12 states on the evaluation of their preservice preparation program in science (3). Results of the survey led to the development of "Recommended Standards for the Preparation and Certification of Science Teachers at the Elementary Level." (4)

Improving the quality of preservice science instruction should have impact in the future on improving the quality of science instruction in the nation's schools. This, however, does not solve the problem of producing quality science instruction at the present time which is dependent on the skill and knowledge of elementary teachers currently teaching in public schools. With a low turnover rate, the improvement of science instruction in the schools will be more heavily influenced by what is done to improve the present teachers' capabilities to teach science than what is done for preservice teachers. In addition, even with a perfect preservice educational preparation program in science, there will always remain the need to continually upgrade teachers' backgrounds with new developments in science and in the teaching of science.

III. Purpose of the Survey

This survey was conducted by the Preschool/Elementary Committee of NSTA in order to determine the needs of elementary teachers with respect to the teaching of science. Once these needs were determined, this would enable the Committee to design in-service workshops based on their needs that would help teachers become more proficient in the teaching of science.

Because the Preschool/Elementary Committee had conducted the previous survey on teachers' perceptions of preservice preparation in the teaching of science, this survey was used as the basis for conducting a more detailed survey. The 1983 survey was constructed and analyzed to determine teacher needs according to grade levels, years of experience in teaching, the size of the school district, the region of the United States, the type of residential setting, and the college degree held.

IV. Methods and Procedures

Survey Preparation

Questions for the 1983 survey were modeled after those used in the 1982 survey of elementary teachers on their preservice preparation for the teaching of science. These were expanded to include several new items plus the following demographic data: grade level, years of experience, size of school district, region of the U.S., residential setting, and college degree held. The first draft of the questionnaire was sent to the NSTA offices, board members, Preschool/Elementary Committee and Referral Group. Sixteen persons responded and this resulted in a second draft that was scrutinized by 22 members of the committee who approved it unanimously. A copy of the instrument is included in the Appendix.

Sampling Procedure

The sample for this survey consisted of 252 elementary teachers from all geographic regions of the United States. The instrument was distributed by 100 elementary school principals that were randomly identified by the National Association of Elementary School Principals from a cross-section of their memberships. Each principal was mailed 10 copies of the questionnaire and was asked to distribute them to ten elementary teachers in grades K-6 who were currently teaching elementary science. A self-addressed stamped envelope was included for use by the principal in returning the surveys. Of the 283 surveys returned, 252 arrived in sufficient time for the computer analysis.

Data Analysis

Data were analyzed using a cross tabs program in order to determine if there were differences in the percentage of responses according to the six demographic variables of interest. These were: (1) grade level currently being taught; (2) years of experience teaching; (3) size of school district; (4) region of the U.S.; (5) type of residential setting; and (6) college degree held.

In order to see the trends in the data more closely, results of the analysis are presented in terms of graphs of percentages rather than in table form. Comparisons made within and between graphs make the data easier to comprehend.

V. Description of the Sample

The sample for the study can easily be described by examining Figures 1 - 6. Teachers were rather evenly distributed from grades K through 6, the group for whom the questionnaire was intended (Figure 1). Most teachers had from 6-15 years of teaching experience (Figure 2), and were in school districts of over 1000 (Figure 3). The highest percentage of teachers participating in the survey were from the northcentral region of the United States and a very low percentage were from the southwest (Figure 4). Teachers from urban, rural, and suburban schools answered the questionnaire, and while there was a higher percentage of suburban participants, a representative number of both urban and rural teachers participated (Figure 5). The most common degree held by the teachers was the bachelors degree and no one held a doctorate (Figure 6).

VI. Survey Results

Survey results will be discussed in terms of each item on the survey analyzed according to each of the six demographic variables.

Question 1: Topics Taught at Grade Level

Teachers were asked to select from a list of 25 topics those that they teach at their grade level. For purposes of presenting and interpreting the data, these have been divided into three categories: biological science, physical science, and earth science. Results are shown in Figures 7-12 for biological science topics, 13-18 for physical science topics, and 19-24 for earth science topics.

Biological Science

Figure 7 shows that the most commonly taught biological or life science topics in elementary classrooms is the characteristics of plants and personal hygiene. About 80% of all teachers in each grade taught these two topics. Topics less generally taught are characteristics of invertebrates, human biology, and adaption. There is much variation according to grade level as to what is taught. Figure 8 shows that the experience of the teacher is generally not a large factor as to life science taught in the elementary classrooms. Less experienced teachers, however, do tend to spend more time on personal hygiene and less time on growth and reproduction, human biology, and adaption than more experienced teachers.

Figure 9 shows that teachers in small districts claim to teach all the biological topics. This is misleading, however, because the sample size was one. On all subsequent figures for school district size this data should be disregarded. As districts become larger, less human biology is taught.

There are also differences in biological topics taught according to geographic regions as shown in Figure 10. In the southwest, less attention is given to the study of the characteristics of vertebrates and invertebrates, growth and reproduction, and adaption. More time is spent on personal hygiene than in other parts of the country. Although there are some other fluctuations in other geographic regions, none are particularly noteworthy.

Figure 11 shows that the variation in biological topics taught in elementary classrooms across the country is not drastically different in urban, suburban, or rural settings. Urban schools appear to stress the characteristics of vertebrates and invertebrates more than average and in suburban schools there is slightly less emphasis on those two topics as well as adoption.

Biological topics taught in the elementary grades also vary according to the teachers academic background as shown in Figure 12. Teachers with credits beyond the masters degree generally teach all biological topics more than less experienced teachers, the only exception to this being the characteristics of vertebrates and invertebrates and health.

Physical Science

The status of teaching physical science topics is shown in Figures 13-18. From a comparison of Figure 7 and Figure 13, it is evident that more biological science is taught in elementary classrooms than physical science. Examination of Figure 13 shows that the most common physical scinece topic taught at every grade level except K and 1 is energy. The least two common physical science topics taught at the lower grade levels are elements/compounds and electricity. Figure 14 shows that as with the biological science, few differences in topics taught are related to the years of teaching experience. Teachers with fewer years of experience seem to teach elements and compounds less. Teachers with between 16-20 years of experience also tend to teach physical science topics less than all other teachers.

Figure 15 shows that as with the biological topics, teachers in small school districts claim to teach almost all physical science topics more than teachers in larger districts. Variations according to district size, the most notable being the small percentage of teachers in districts from 500-750 who teach electricity and the small percentage in districts over 100 that teach elements and compounds. Figure 16 shows that there is some variation of the physical science topics taught according to geographic region. Energy is taught less in the southeast than in other regions across the country. Most physical science topics listed were taught by fewer teachers in the northcentral states than in other regions. Figure 17 shows that suburban schools teach less physical science than schools in other residential settings. Figure 18 shows that teachers with masters degrees generally teach less physical science than teachers with both more and less academic credits.

Earth Science

Figures 19-24 depict the percentage of teachers who teach the various earth science topics. A comparison of figures 7, 13, and 19 shows that earth science topics are taught by more teachers than physical science topics, but by less teachers than biological science topics. Figure 19 shows that the least taught earth science topic is oceanography followed by aerospace exploration. The most popular topics are environmental education and weather (except at 3, 4, and 6). Fifth grade teachers appear to teach more earth science topics than others. Figure 20 shows little differentiation of earth science topics taught according to teaching experience. Except for the very small interest in teaching oceanography by districts from 750-1000 other earth science topics, although not taught to the same degree in all districts, do not show any major variations. Slight variations of earth science topics taught occur in different geographic region where more variation might be expected. The most noteworthy difference according to region as shown in Figure 22 is the high interest in aerospace exploration in the southwest. Figure 23 shows only slight variation in earth science topics according to residential setting with urban schools teaching most topics more frequently. Figure 24 shows that although there is variation according to topic on how frequently it is taught by teachers of different academic backgrounds, it is impossible to make generalizations about the variation.

Question 2: Criteria Used to Select Sequencing of the Science Curriculum

Teachers were asked to select which of five criteria were used to select the sequencing of the science curriculum. Figures 25-30 give the findings. Figure 25 shows that at all grade levels other than 6th, teachers felt that the curriculum sequence was determined primarily by integration with other curricula. The second most perceived criteria for selecting the curriculum sequence was the publisher of the text. In grade 6, the publisher's suggestion was first. Learning theory was selected as the least likely criteria used to sequence the curriculum. Figure 26 shows that the years of experience has little relationship with teachers' perceptions of who sequences the curriculum except that the least experienced teachers felt that student interest is also an important factor. The size of the district (Figure 27) was also important in teachers' perceptions of criteria to select the sequence of science curriculum. Teachers in small districts felt that the science process skills was the predominant factor.

Perceptions of the criteria also varied according to different geographic regions as shown in Figure 28. In the northwest, publishers' suggestions was the primary determinant and in the southwest student interest was the most important factor.

Figure 29 shows that the type of residential setting is not a large factor in teachers perceptions of who sets up the sequence of the curriculum except that urban and rural teachers take more credence in publishers suggestions than do suburban teachers and that urban teachers selected the science process skills less frequently. Teachers academic backgrounds is also not an important factor in teacher perception of the criteria. Teachers with more academic preparation do believe that learning theory plays a more important role.

Question 3: Criteria Used to Select the Content of the Science Curriculum

This question focused on the content of the science curriculum rather than on the sequencing of the curriculum. Figures 31-36 present the results. Figure 31 shows that teachers of all grade levels except 1st thought that science content was determined by the science committee and that the least instrumental group in making this decision was the building administrators. More first grade teachers than those teaching other levels thought that the teachers' choice determined the content of the curriculum. Teachers of 0-10 years of experience more frequently thought that the content was set by policy makers than did more experienced teachers as is shown if Figure 32. Figure 33 shows that a higher percentage of teachers in small school districts thought that the science committee made the decisions to select the content than did teachers in larger school districts.

There were also differences in teachers' perceptions about who selected the science content according to geographic regions. In the southwest, teachers predominately thought it was selected by policy makers. This was true to a large extent also for teachers in the south central region.

Figure 35 shows that suburban teachers perceive that the science committee sets the curriculum less frequently than teachers in other residential settings and that the science curriculum director has a greater voice in the content selection. Figure 36 shows that teachers with better academic preparation thought that the science committee most frequently selected the science content.

Question 4: Most Common Methods of Instruction Used in the Teacher's Science Classroom

Figures 37-42 display the most common methods of instruction used in your science classroom. Teachers were asked to select the three most common methods. Figure 38 shows that the three most common types were hands-on, the text, and large group. Hands-on was indicated by 88% of the teachers. It is greatest in kindergarten as shown in Figure 37. The use of the textbook exceeds that of hands-on beginning in grade 4. The least common method of instruction is computer-assisted instruction. Figure 38 shows that the most experienced teachers tend to use the text more and the lecture least. Figure 39 indicated that very small districts use all types of instruction but because there was only 1 teacher in this category, the finding is not generalizable to other teachers. No other trends are evident according to district size.

Figure 40 shows the distribution of the various methods of instruction according to geographic regions. In the northeast and southeast, hands on activities are used a little more frequently than the average. The lecture is used less frequently than average in the southwest, and small groups less in the northcentral states.

There are little differences in the mode of instruction according to residential setting (Figure 41), although suburban teachers tend to use hands-on more and texts less than teachers in other residential settings. Figure 42 shows that teachers with the most academic background tend to use the text, hands on activities, CAI and large groups more than other teachers and multi-media instruction less.

Question 5: Process Based National Curriculum Projects Used in the Last Two Years of Science Instruction

Teachers were asked to indicate which of the national curriculum projects they used within the last two years of science instruction. Five categories were listed: ESS, SAPA, SCIS, Other, and None. Figures 43-48 display the findings. Figure 43 shows that of the three listed projects, SCIS was the most commonly used, followed by ESS. SAPA was used by few teachers. SCIS was the most popular kindergarten program excelling even other projects and other approaches. ESS was more popular in the upper grades than the lower grades. Teachers who were very experienced (more than 20 years) were greater users of ESS and SCIS than less experienced teachers (Figure 44). Figure 45 shows that large school districts tend to use ESS and SCIS more frequently than smaller districts but even these districts more frequently do not use the national curriculum projects.

The use of the national curriculum project varied greatly by geographic region, as shown in Figure 46. In the northwest, SCIS was the most commonly used curriculum. The southcentral and southwestern states generally did not use the national curriculum project.

SCIS and ESS were taught more frequently in suburban schools than in urban and rural schools, as depicted in Figure 47. These two programs were used by very few teachers in rural situations. The use of the national curriculum project appears from Figure 48 to have little relation to the teachers academic preparation.

Question 6: Factors that Would be Most Helpful to Improve Science Instruction

Factors that teachers thought that would be most helpful in improving science instruction in their situation are displayed in Figures 49-55. Teachers were asked to judge each of seven factors as either helpful or not helpful. The factors are: (1) Packaged science kits and teacher guides; (2) Work on science concepts; (3) Work on organized science activities; (4) Work on individualizing science; (5) Work on the use of science equipment; (6) Work on basic skills through science; and (7) Work on the use of the current science program. Due to an error in the formating of the questionnaire, teachers were asked to use the last three spaces of their answer sheet for the items 5, 6, and 7. Because of this, it is impossible to tell whether many teachers did not respond to select 5, 6, and 7. Because of this location and the findings for these three items must be interpreted with care. Figure 49 shows that teachers feel that the most useful approach to improving science instruction is to provide science kits and teacher guides. This is followed by working on organized science activities and science concepts. Working on science equipment and basic skills had low priority, and even lower priority than working on using their current science program. Again, consideration must be given to the fact that for these last three items, 20% of the teachers left the items blank because they were located at the end of the questionnaire and the directions to select the three most important were somewhat confusing. Few differences in opinion were seen according to teachers' years of experience (Figure 50).

Figure 51 is misleading because of only one subject in the under 250 group, shows that teachers in the 500-750 district size range thought that more of the factors would be helpful than other district sizes. In particular, they checked the basic skills. Differences in teachers' perceptions of what factors would be helpful in improving science instruction varied according to geographic region (Figure 52).

In the southcentral and southwest states, teachers thought that training in the basic skills were more important than in other geographic regions. Teachers in every geographic region thought that learning to use science kits and teacher guides would be most helpful. 100% of the teachers (5) in the southwest checked this as being important.

The only noteworthy difference indicated according to residential setting was that urban teachers felt that basic skills and science equipment help would be more useful than teachers in other settings (Figure 53).

Figure 54 shows that teachers with a better academic background did not think that learning science concepts, basic skills, or about organized science activities would be as important as less prepared teachers. Teachers of all academic backgrounds selected science kits and teaching guides as being most important.

Question 7: Areas that Hamper Science Planning/Instruction

Teachers were asked which factors they felt hampered science planning/instruction. Results for whether the listed factors hampered or did not hamper their science instruction are given in Figures 55-60. The areas listed were: (1) Access to catalogs/journals; (2) Availability of library resources; (3) Class size too large; (4) Lab areas insufficient; (5) Class ability range too wide; (6) Lack of science texts for students; (7) Lack of supplies for hands-on activities; (8) Insufficient planning and organizing time; (9) Poor curriculum guide. Figure 55 shows that on every grade level, the lack of supplies was the greatest barrier to teaching science. Insufficient lab areas was also listed very frequently particularly by teachers of 3, 4, 5, and 6. Lack of texts and poor guides were the least listed areas although first grade teachers saw these as relatively more important obstacles than teachers in other grades. Figure 56 shows that as teachers become more experienced, insufficient planning time becomes a more important factor in obstructing science instruction and that all the other areas decrease slightly.

Figure 57 shows that the smaller districts found insufficient laboratory areas and insufficient planning time to be a greater problem than the larger districts. The largest districts as well as most other districts found the lack of supplies to be the greatest hinderence in teaching science. The northeast and southeast teachers selected the wide ability range of children (Figure 58) more frequently than other geographic regions as being a barrier to the teaching of science.

In suburban schools the lack of catalogs/journals and library resources are listed more frequently and in urban schools, class size is a greater factor than in other settings (Figure 59). Rural teachers listed lack of supplies as a greater factor than did teachers in the other two settings. Teachers with more academic preparation was class size and lack of supplies as less of a barrier than others. They listed lack of catalogs/journals and insufficient lab space as greater barriers.

Question 8: Time Required by State Guidelines Per Week

Questions 8, 9, and 10 are concerned with the time spent on science instruction. Question 8 focuses on the time required by the State Guidelines per week. From Figure 61 it is apparent that first grade teachers perceive that they should spend from 60-120 minutes per week teaching science. In general, as the grade level increases, more time is advocated by the state. Very few teachers spend more than 240 minutes per week teaching science and about 30% of the teachers indicated that there were no state guidelines. Figure 62 shows that teachers of varying years of experience perceive the state guidelines in about the same way.

Figure 63 shows that with the exception of the smallest districts (n=1) most teachers thought there were state guidelines and that the amount of time varied considerably according to district size. Figure 64 shows that the time prescribed by the state was different according to geographic regions. In the southwest, teachers perceived a very low science instructional time prescribed by the state.

Figure 65 shows that suburban teachers perceive that the state requires less science instructional time than teachers in other settings. Figure 66 shows that teachers of greater academic background thought that smaller instructional time was prescribed by the state for science than teachers of less academic preparation.

Question 9: Time Required/Suggested by School District Per Week

Teachers' perceptions of the amount of time required or suggested by the school district is depticted in Figures 73-78. Comparison of these figures with Figure 61-72 show that for most grade levels, teachers perceive that the district suggests a greater amount of science instruction than does the state. The same basic pattern according to years of experience is shown in Figure 68 as in Figure 62. Figure 69 shows that teachers in all districts except the largest indicate that between 120-240 minutes of science instruction per week is suggested by the school district. In the largest school districts more districts prescribe 60-120 minutes of science instruction than the larger amount. Figure 70 shows that in general most districts in different geographic regions suggest about the same amount of time with the exception of the southwest that suggests only 0-60 minutes of science instruction per week.

The same pattern is shown in Figure 71 as was shown in Figure 65 with rural settings requiring more science instruction than suburban or urban settings. Teachers with more academic preparation (Figure 72) perceive that the district suggests less science instruction than teachers with less academic preparation.

Question 10: Average Time of Instruction Per Week

Figures 73-75 show the average time teachers report that they actually spend on teaching science. A comparison of these figures with Figures 61-66 and 67-72 show that teachers in grades 2-6 spend more time teaching science than their perception of how much time is required/suggested by the state or by the district. First grade teachers tend to spend less. No generalizations can be made concerning the relationship between years of teaching experience and the amount of time a teacher spend teaching science (Figure 74). Figure 75 shows that teachers in larger districts tend to spend less time in teaching science than teachers in smaller districts. Figure 76 shows that teachers in the northwest spend more time teaching science than the average and teachers in the northeast spend less time than average. Figure 77 shows that suburban teachers spend less time and rural teachers more time than average in teaching science.

The type of residential setting (Figure 77) has the same relationship to the amount of science taught as to the amount of science teachers are expected to teach according to the state (Figure 65) and the school district (Figure 71). Figure 78 shows that the teachers with better academic preparation spend less time in teaching science than teachers with less academic preparation.

Question 11: Adequacy of Science Instruction in Teachers' Schools

When asked whether they thought that science was adequately taught in their school, about 50 percent of the teachers responded in a positive way as is shown in Figures 79-84. Results depicted according to grade in Figure 79 show that teachers in grades 5 and 6 tend to think less positively about the adequacy of instruction than do teachers of the lower grades. No strong differences are found among teachers of varying teaching experience (Figure 80) although teachers with more experience tend to think that science instruction is more adequate. Figure 81 shows that more teachers think that instruction in science is adequate in their school than think it is inadequate. Differences according to the size of the district (Figure 82) do not follow any specific trend. It should be noted that teachers in the southwest feel strongly that it is not adequately taught in their region.

Teachers in rural settings appear to think that science is more adequately taught in their schools than their counterparts in other residential settings (Figure 83). Differences according to teachers' academic background are not significantly different (Figure 84).

Question 12: Science Program or Curriculum in Use

Teachers were asked which textbook/science program they were currently using. The findings are shown if Figures 85-90. D.C. Heath was the most popular over-all text (Figure 85) of those listed although Addison-Wesley was more popular for grades 1 and 2. Many teachers (50%) did not select one of the texts listed on the survey probably indicating that they were using another textbook or perhaps none at all.. Differences between texts used by teachers of varying experience was minimal although more experienced teachers used Holt, Rhinehart, Winston more than the others (Figure 86). Figure 87 indicates that the D.C. Heath service was more frequently used in all sized districts with the exception of district from 500-750 where it was superceded by both the Addison-Wesley and Charles Merrill series. Figure 88 shows that D.C. Heath is widely used in the northwest region of the U.S.

In different residential settings there is a noteworthy difference between texts used. The various texts were used in about equal proportion by suburban teachers, however, rural and urban teachers were using primarily the D.C. Heath series. Figure 90 shows that more experienced teachers used the D.C. Heath series than the Addison Wesley or the Holt, Rhinehart and Winston series. Because textbooks are selected according to school or district, this data does not have much meaning.

VII. Recommendations and Conclusions

Results of this survey have implications for the teaching of science in the elementary schools of our nation. Some of the findings should serve as guidelines in the implementation of in-service workshops for elementary teachers. Others, such as the fact that terachers indicated that the factor that would be most helpful in improving science instruction was having packaged science kits and teacher guides, can be used to justify increased funding for science instruction on both the local and national level.

The following recommendations pertain to implementation of the survey findings for in-service workshops for elementary teachers.

1. Science Topics

Teachers tend to spend more time teaching the life sciences than physical science or earth science. For this reason it is recommended that workshops stress physical science and earth science rather than biological science. In particular elements/compounds, electricity, and aerospace exploration should be topics given higher priority always taking into consideration of the grade level of the children, however. This recommendation is made with the assumption that teachers teach the topics with which they are comfortable, familiar, and adequately prepared, that is biological topics.

2. Science Methods

High percentages of teachers indicated that they used hands-on activities in the classroom. This may be true because principals were instructed to give the questionnaire to teachers who were teaching science and they may have distributed them to teachers using this method of instruction. No recommendation concerning science methods can be made from the data collected, as teachers appear to be using a variety of methods and are comfortable with hands-on approach.

3. Teachers' Needs

Teachers indicated the most useful thing that would help them improve science instruction was kits and teaching guides. These cannot be supplied in in-service instruction. Teachers did indicate that work on organized science activities and work on science concepts would be most helpful -- more so than on science equipment and basic skills. If in-service workshops are based on teachers' needs as they perceive them, they will be content rather that process-skill oriented. There were, however, no questions in the survey to examine how well teachers understood the basic science process skill and their applicability. to the teaching of science is the elementary classroom.

4. Overcoming Obstacles to Good Science Instruction

Teachers rate the lack of supplies/equipment as the greatest barrier to teaching. This might suggest that in-service workshops focus on ways teachers can teach science without expensive equipment, that is, how to prepare simple equipment themselves. However, experienced teachers indicated that lack of planning time was their major obstacle. Making and gathering equipment would simply add to this problem. There is no ready solution. It appears that if equipment were available, more teachers would use it.

The results of this survey indicate that more elementary teachers are either using a textbook or their own materials in the teaching of science. Very few are using the process-oriented national curriculum developed in the 60's. Teachers interest in learning science concepts rather than the science process skills seems to indicate that science instruction in the elementary schools have become fact and concept centered rather than process-skill centered. Although a large number of teachers indicated that children in their classrooms were using hands-on activities, from this survey there is no way of knowing whether the hands-on activities are process skill oriented.

The data from this survey was analyzed according to six major demographic variables. Care must be taken in interpreting the data when the sample size for a particular subsection is small and therefore not representative of the population. This is particularly true for school districts of less than 250 and the southwest geographic region. The above recommendations are made for in-service workshops that would be attended by teachers throughout the nation.

Educators planning workshops in their own districts should consider the results of the survey according to the demographic variables applicable to their district in their given geographic region. Better yet, if time permits, the questionnaire used in this survey should be reproduced and administered to the teachers for whom the workshop is intended. In this way the workshop would be tailored to the needs of the teachers in attendance and will be a more valuable educational experience for them which should lead to better science instruction in our nations' schools.

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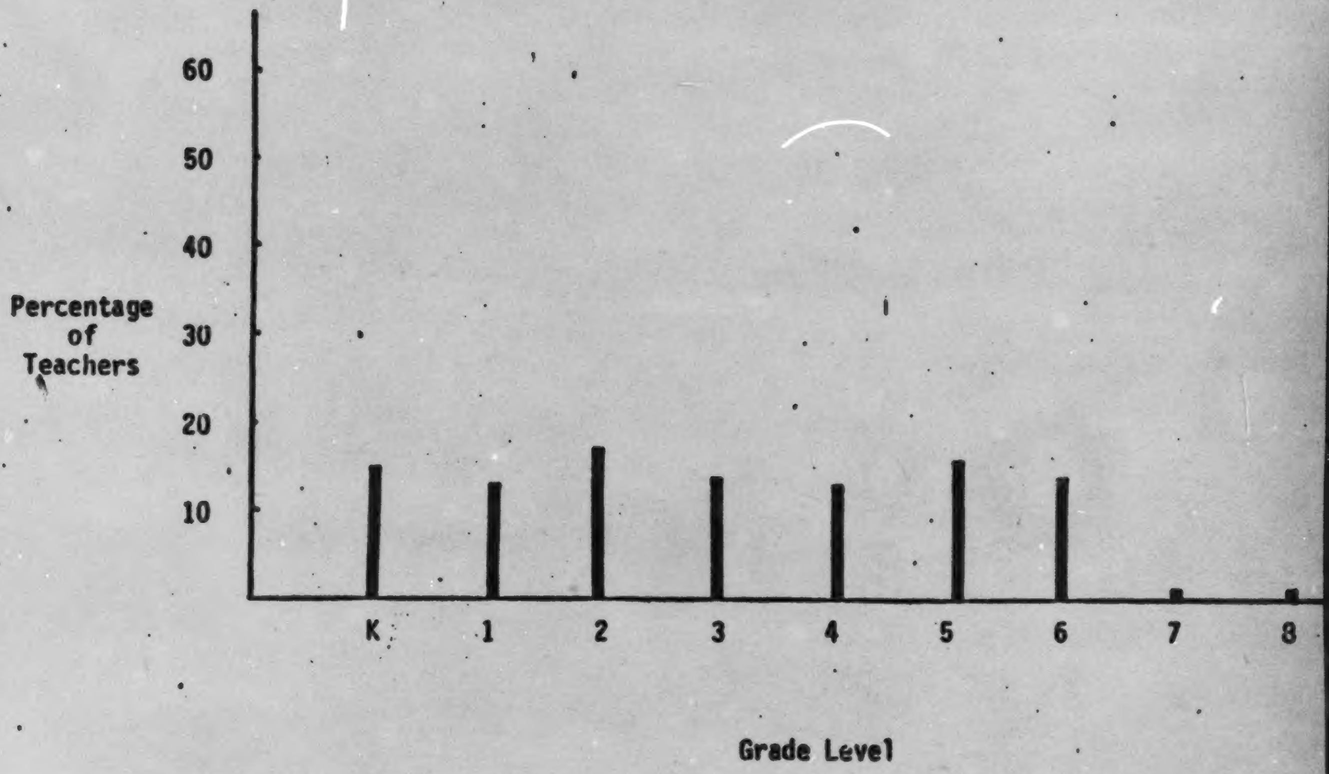


Figure 1. Grade level of participants taught in 1982-83.

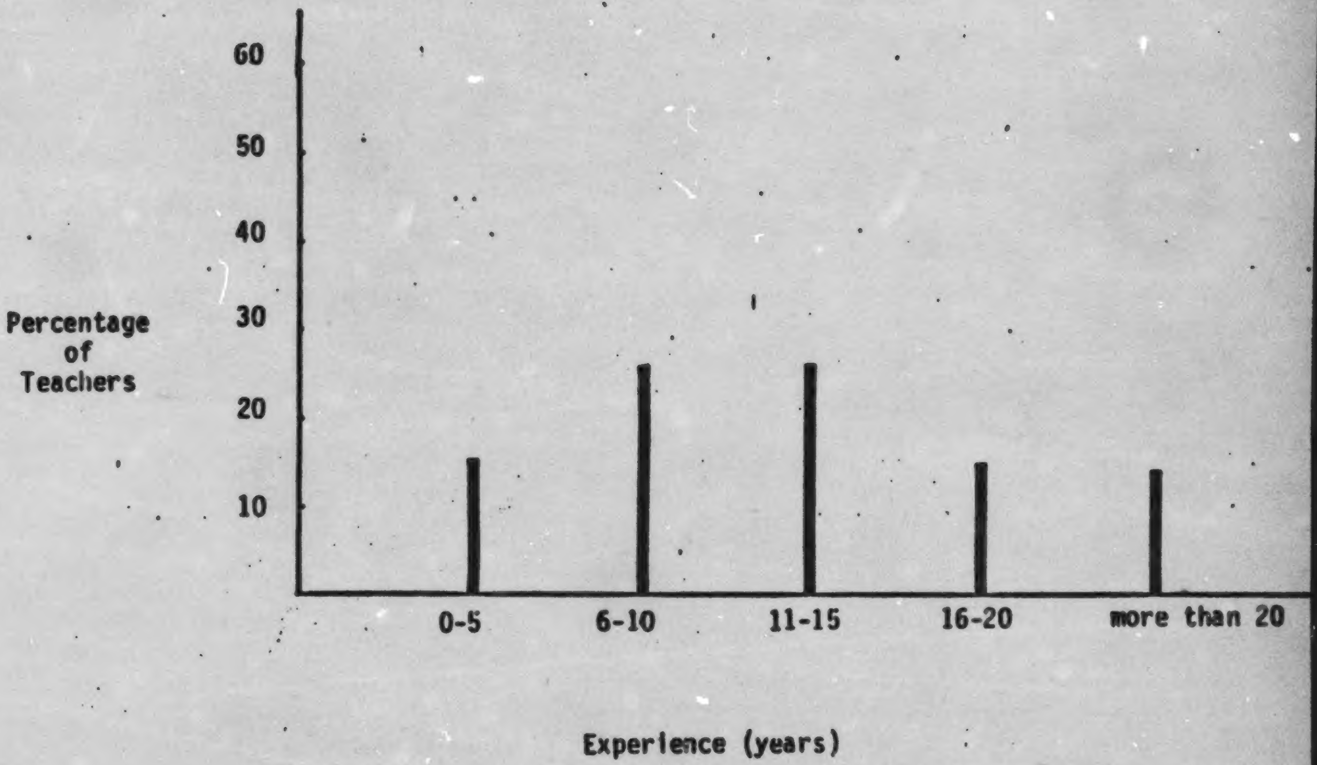
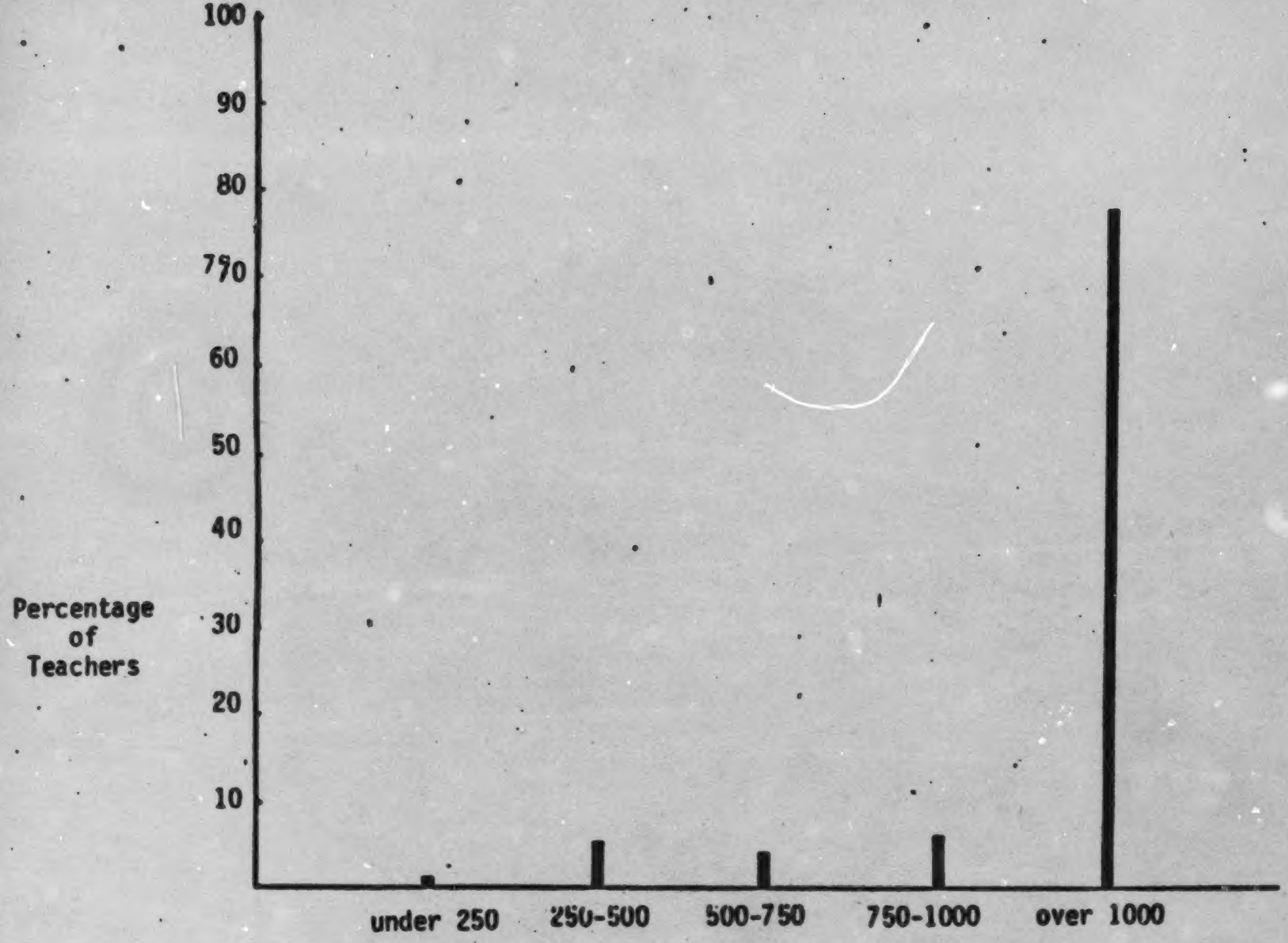


Figure 2. Years of experience in teaching.



Size of School District

Figure 3. Size of school district of participants.

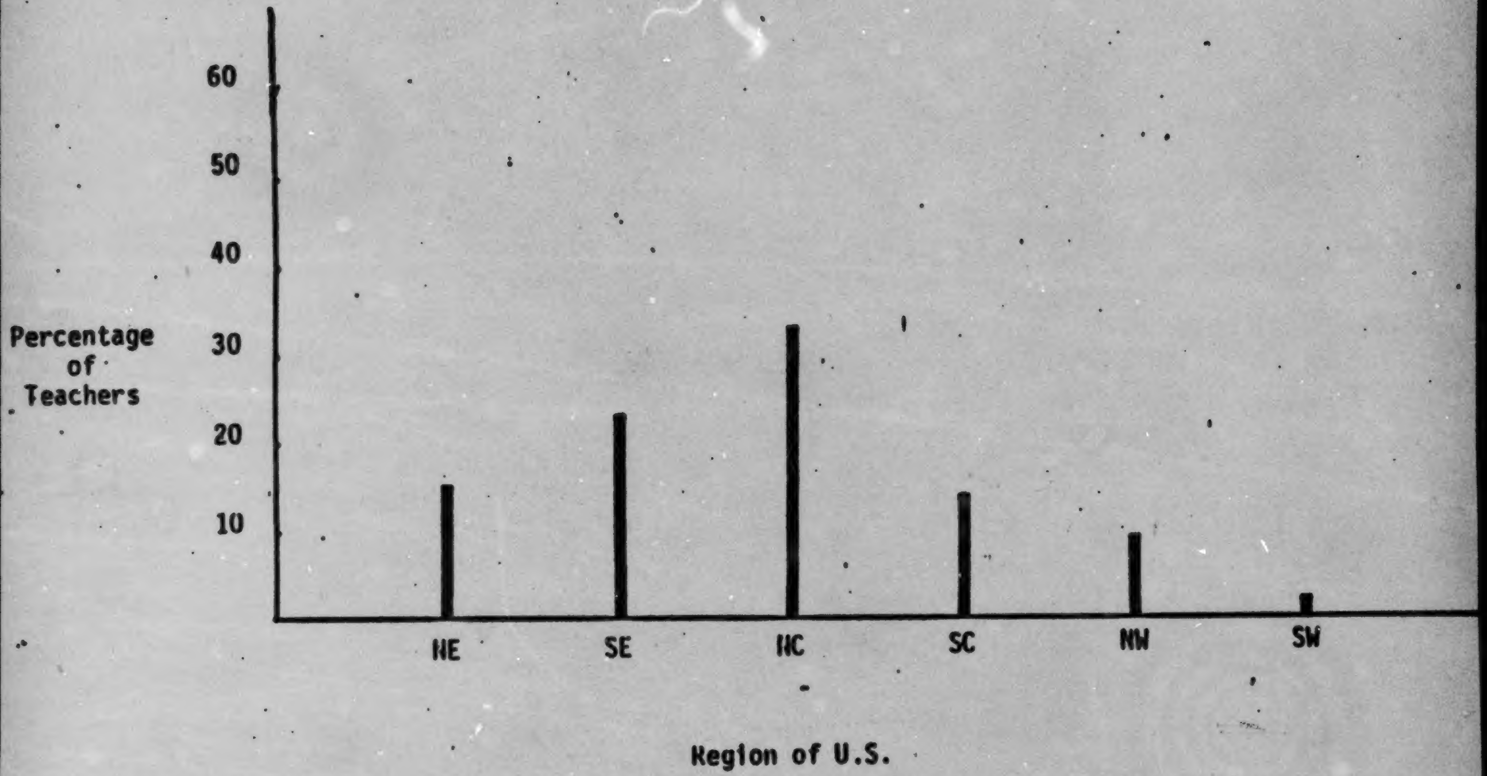


Figure 4. Region of U.S. of participants.

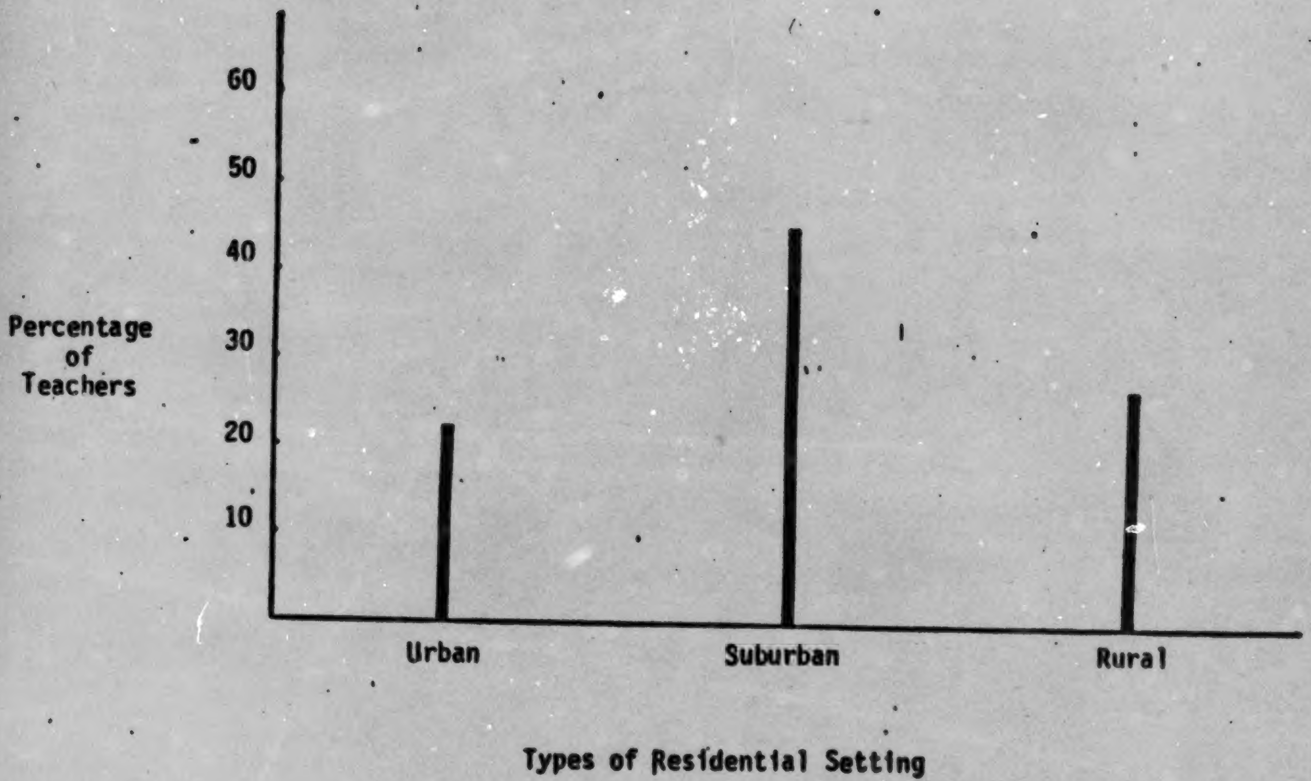


Figure 5. Type of residential setting of participants.

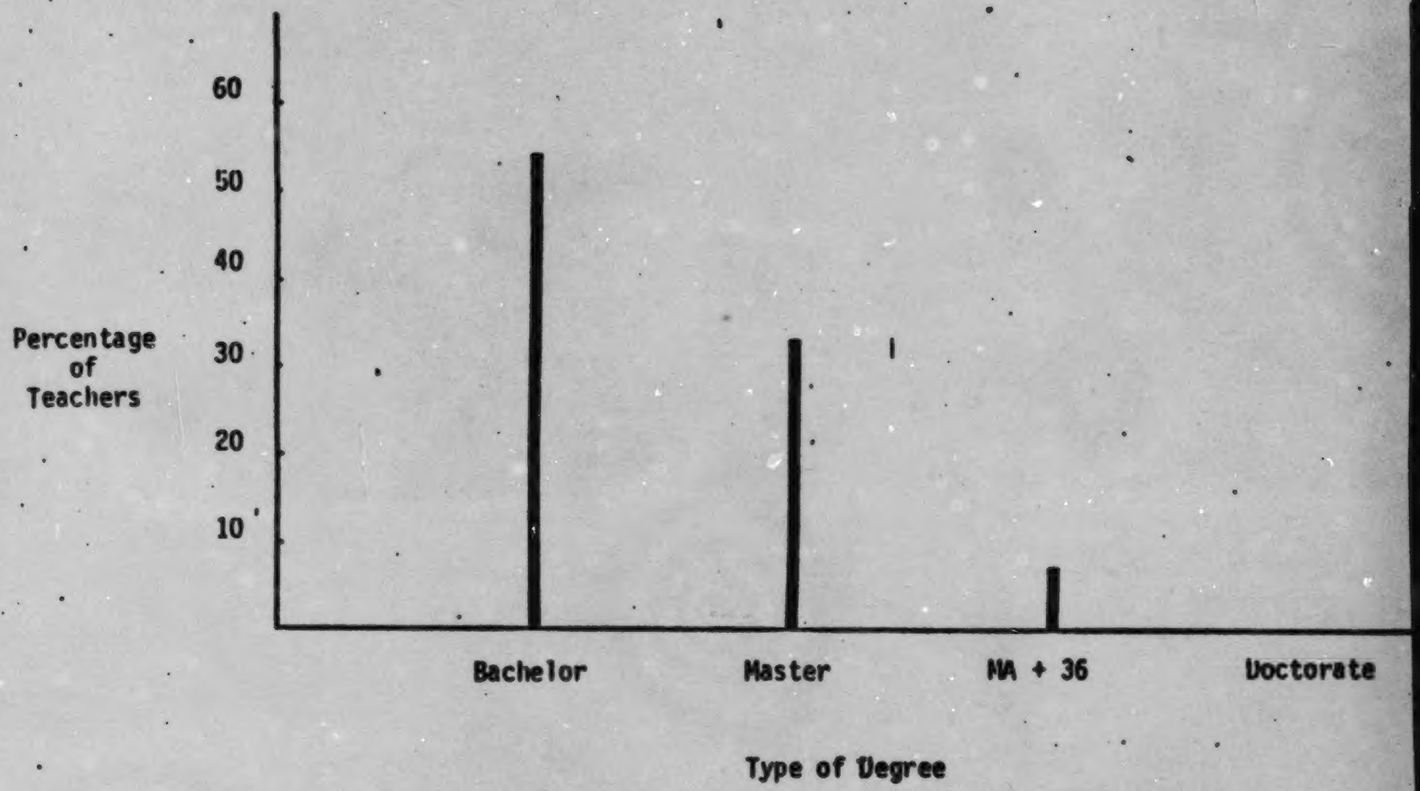
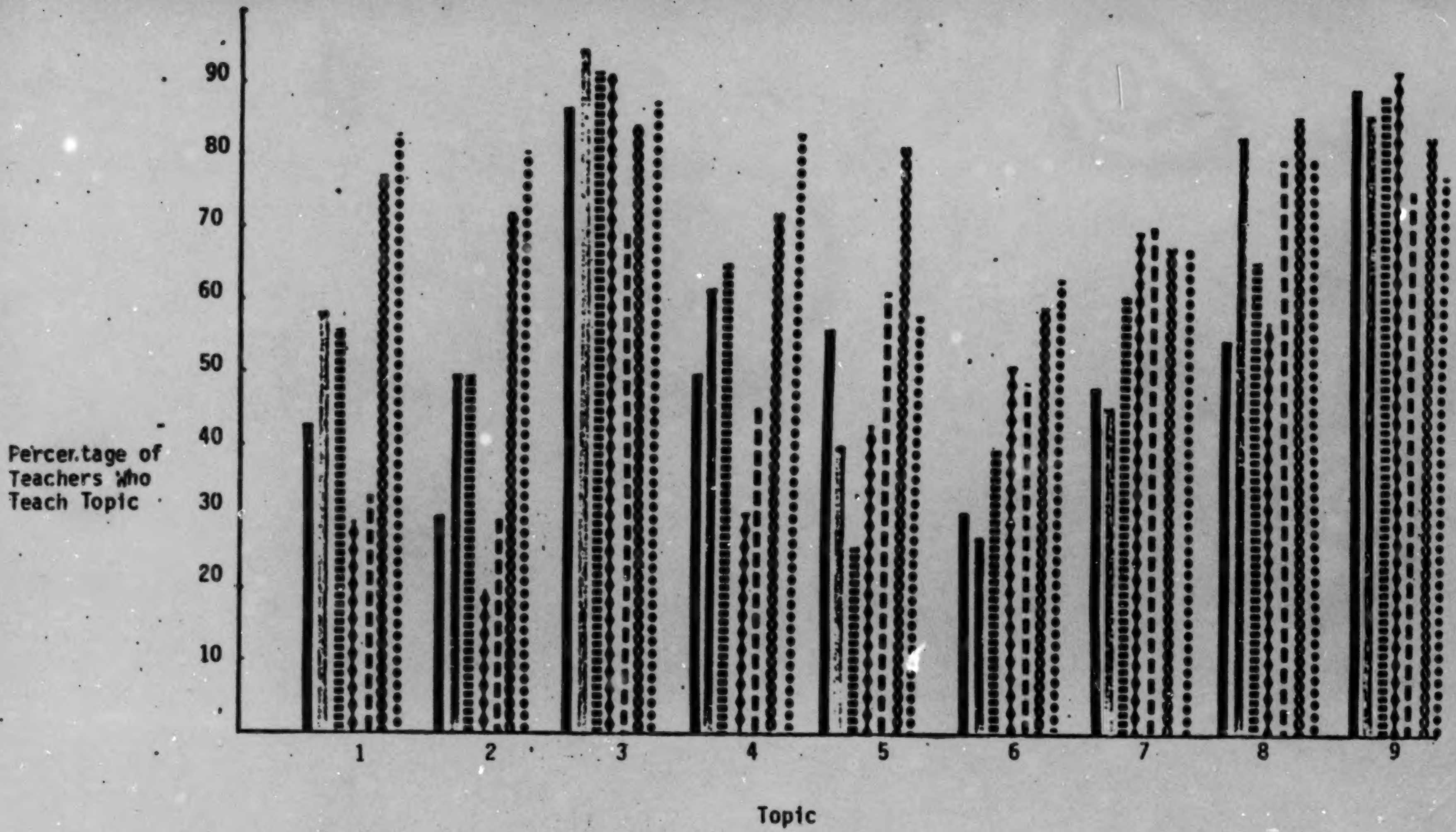


Figure 6. College degree held by participants.



Topics:
1. Charact. of Vertebrates
2. Charact. of Invertebrates
3. Charact. of Plants
4. Growth and Reproduct.
5. Human Biology
6. Adaption
7. Populations, Ecology
8. Life Cycles
9. Personal Hygiene

▬ K
•-• 1st
▮▮▮ 2nd
•◆• 3rd
▬•• 4th
◆◆◆ 5th
••• 6th

Figure 7. Biological topics taught according to grade.

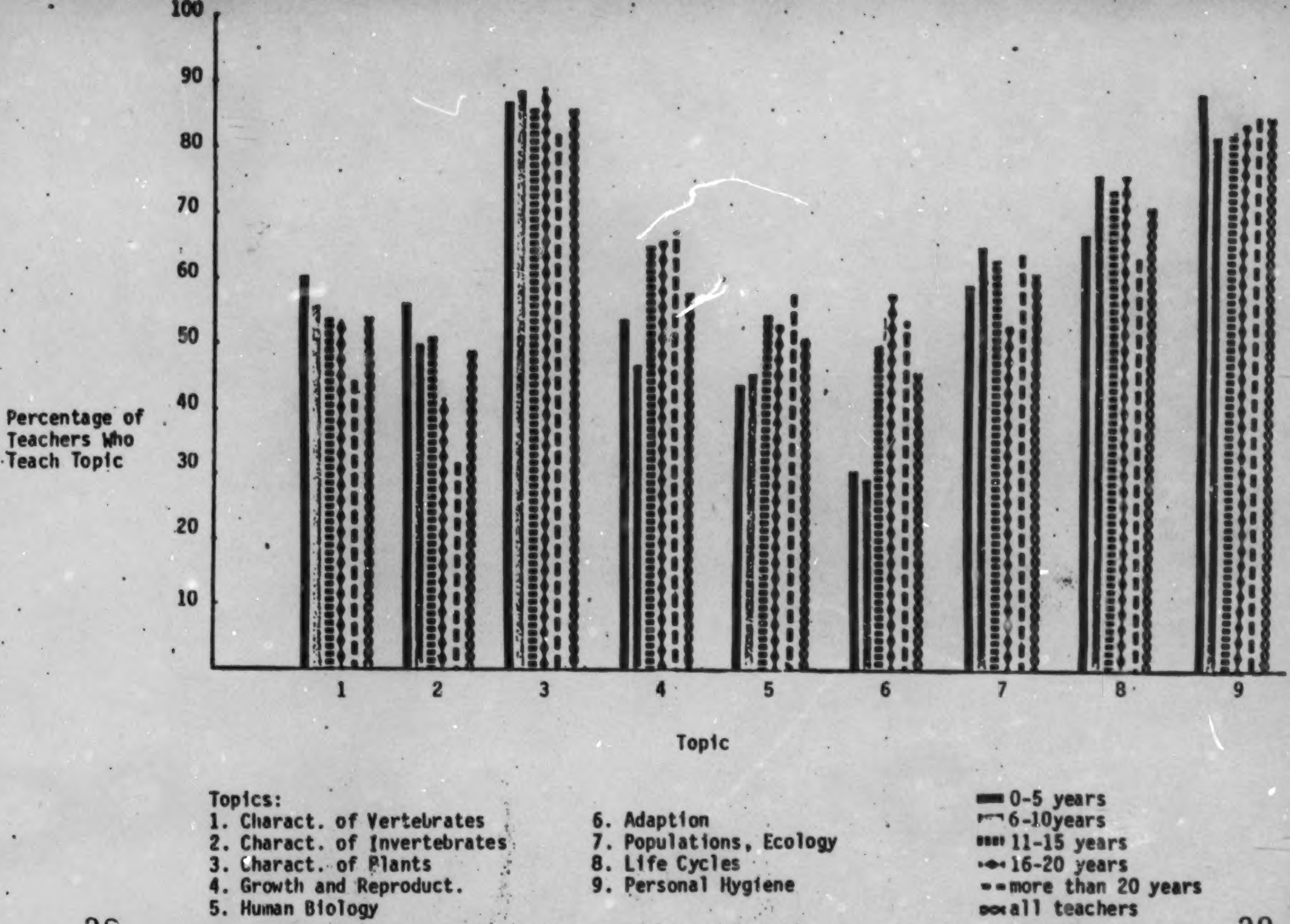


Figure 8. Biological topics taught by teachers of various years of teaching experience.

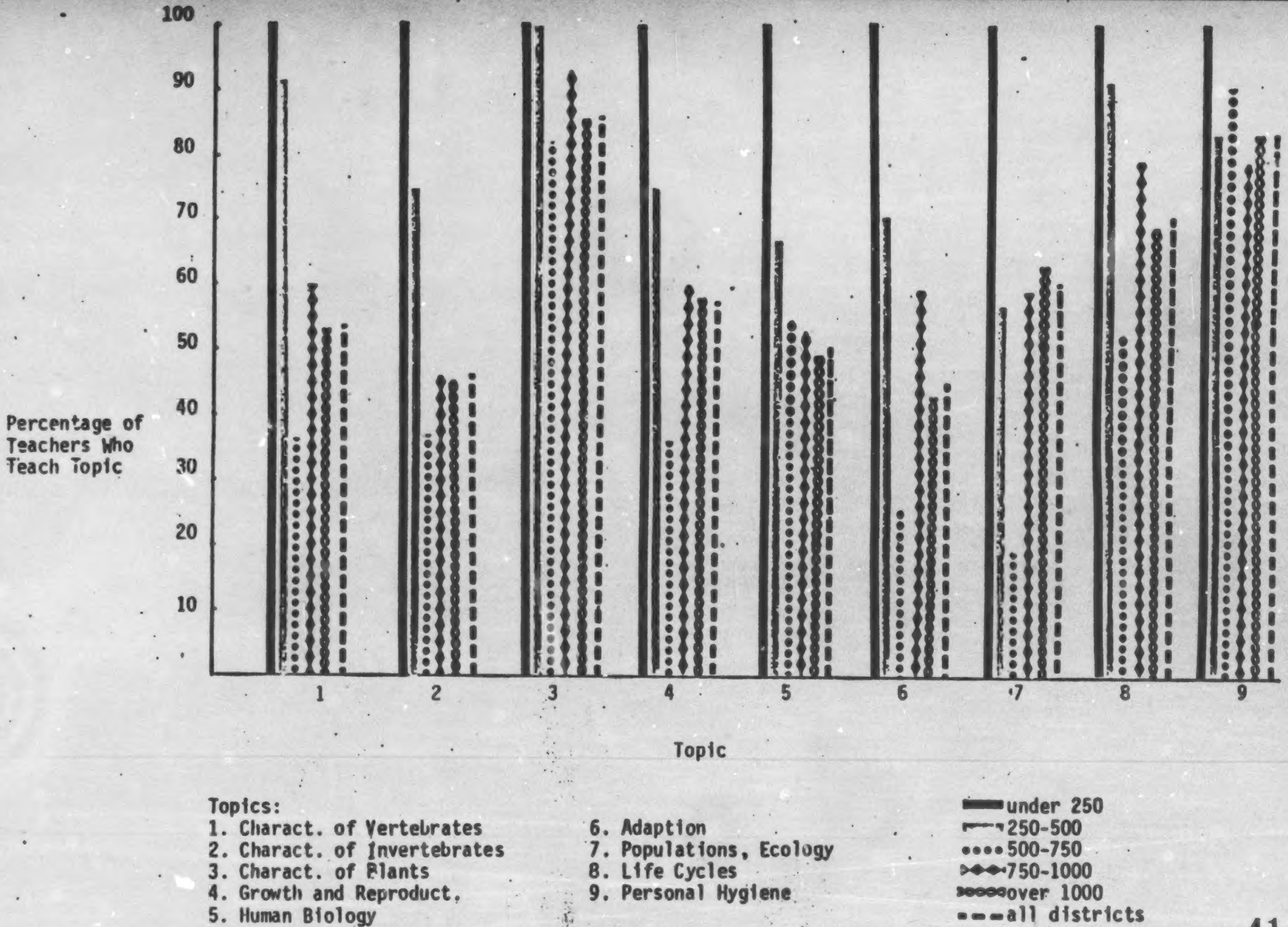


Figure 9. Biological topics taught according to school district size.

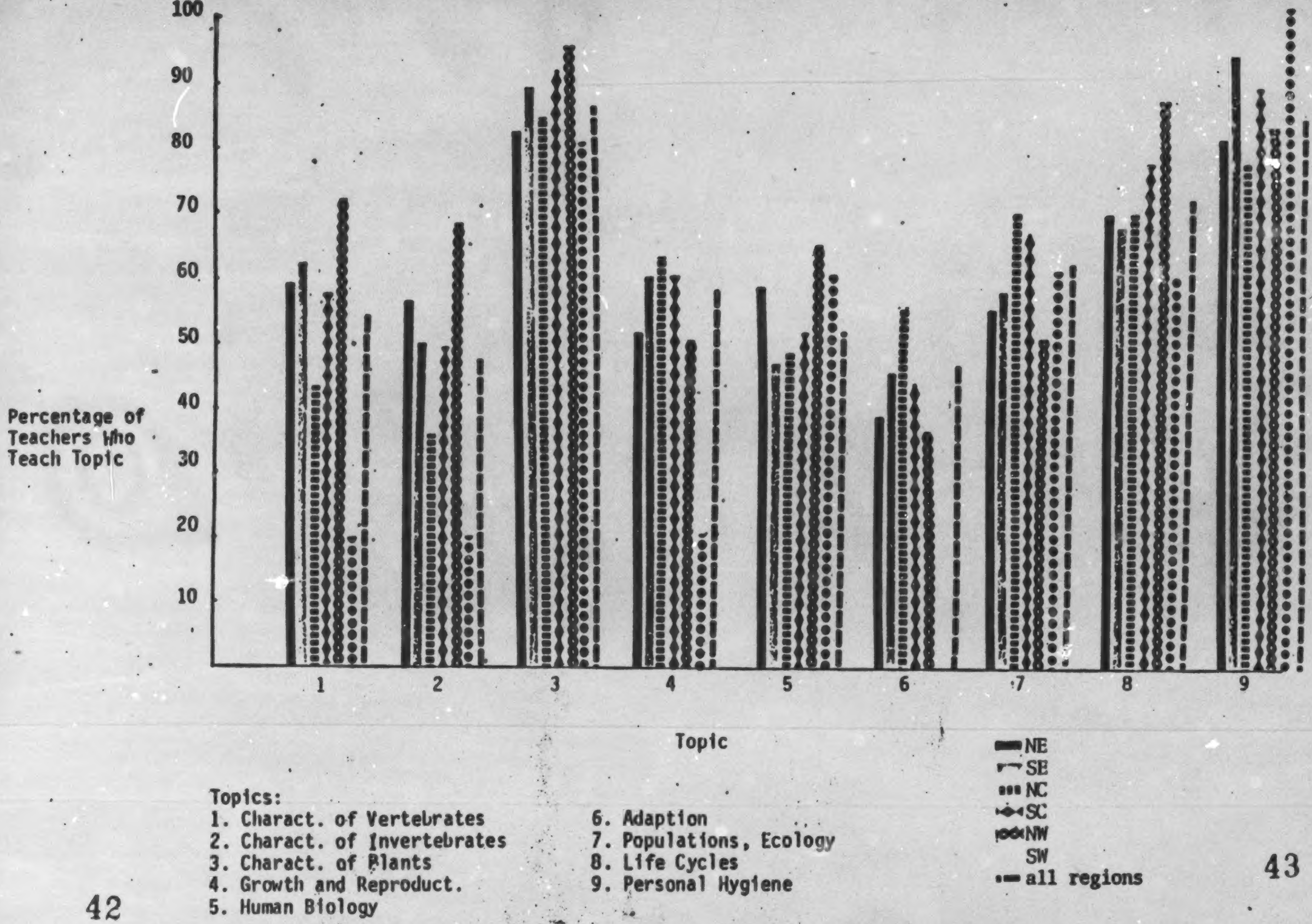
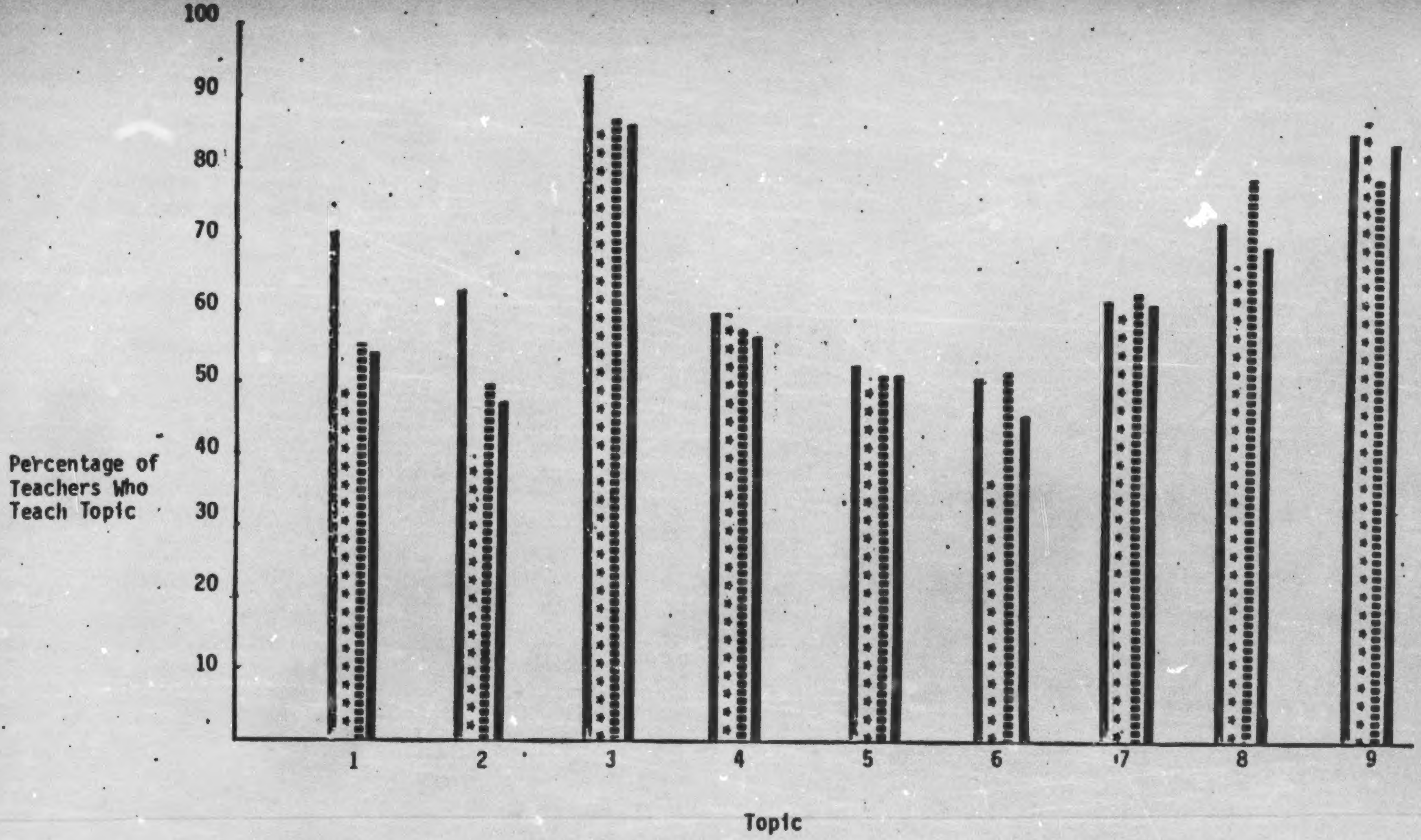


Figure 10. Biological topics taught in different geographic regions in the U.S.



Topics:
1. Charact. of Vertebrates
2. Charact. of Invertebrates
3. Charact. of Plants
4. Growth and Reproduct.
5. Human Biology
6. Adaption
7. Populations, Ecology
8. Life Cycles
9. Personal Hygiene

— urban
• • suburban
▪▪▪▪ rural
■■ all settings

Figure 11. Biological topics taught in different types of residential settings.

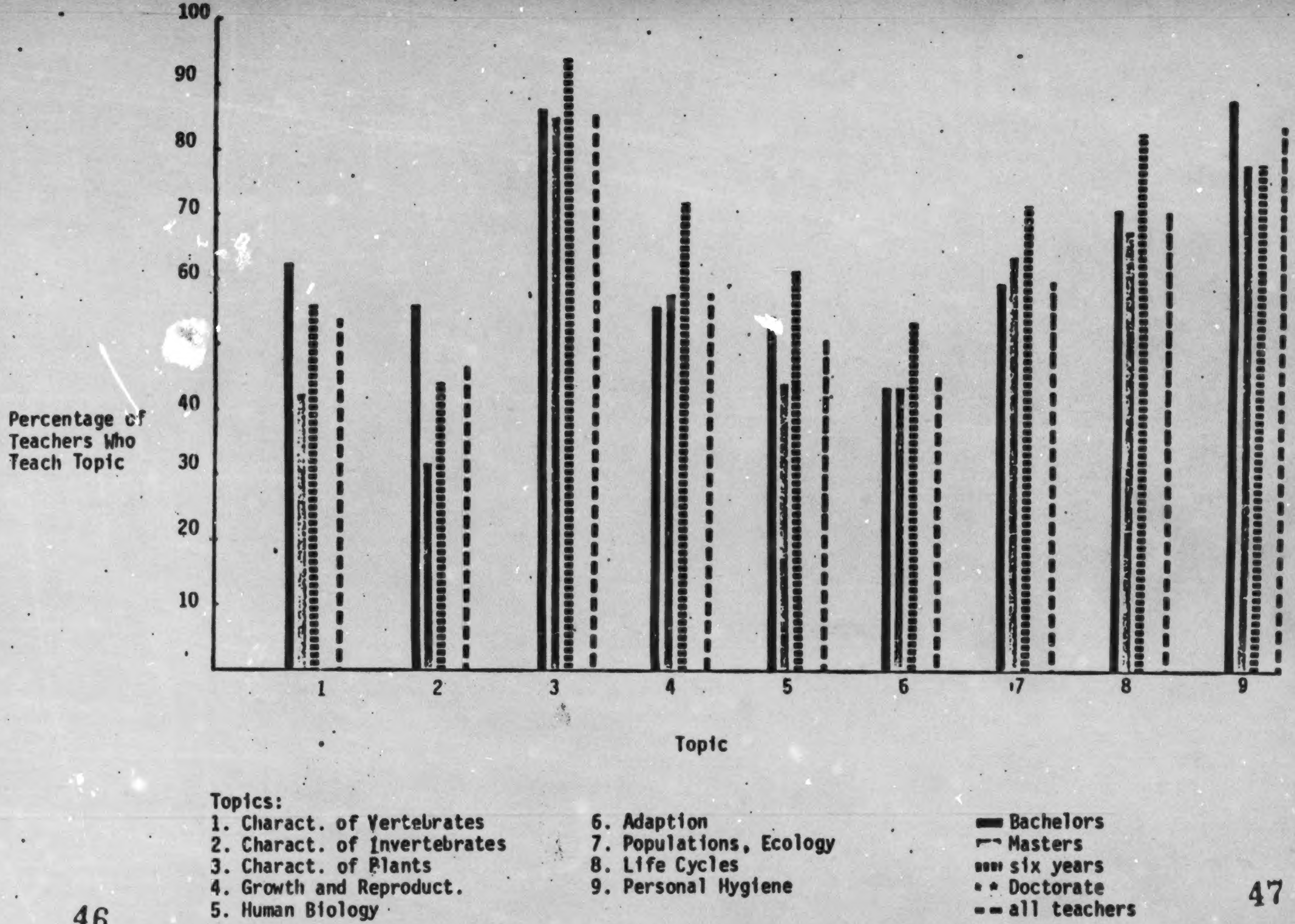


Figure 12. Biological topics taught by teachers of various academic backgrounds.

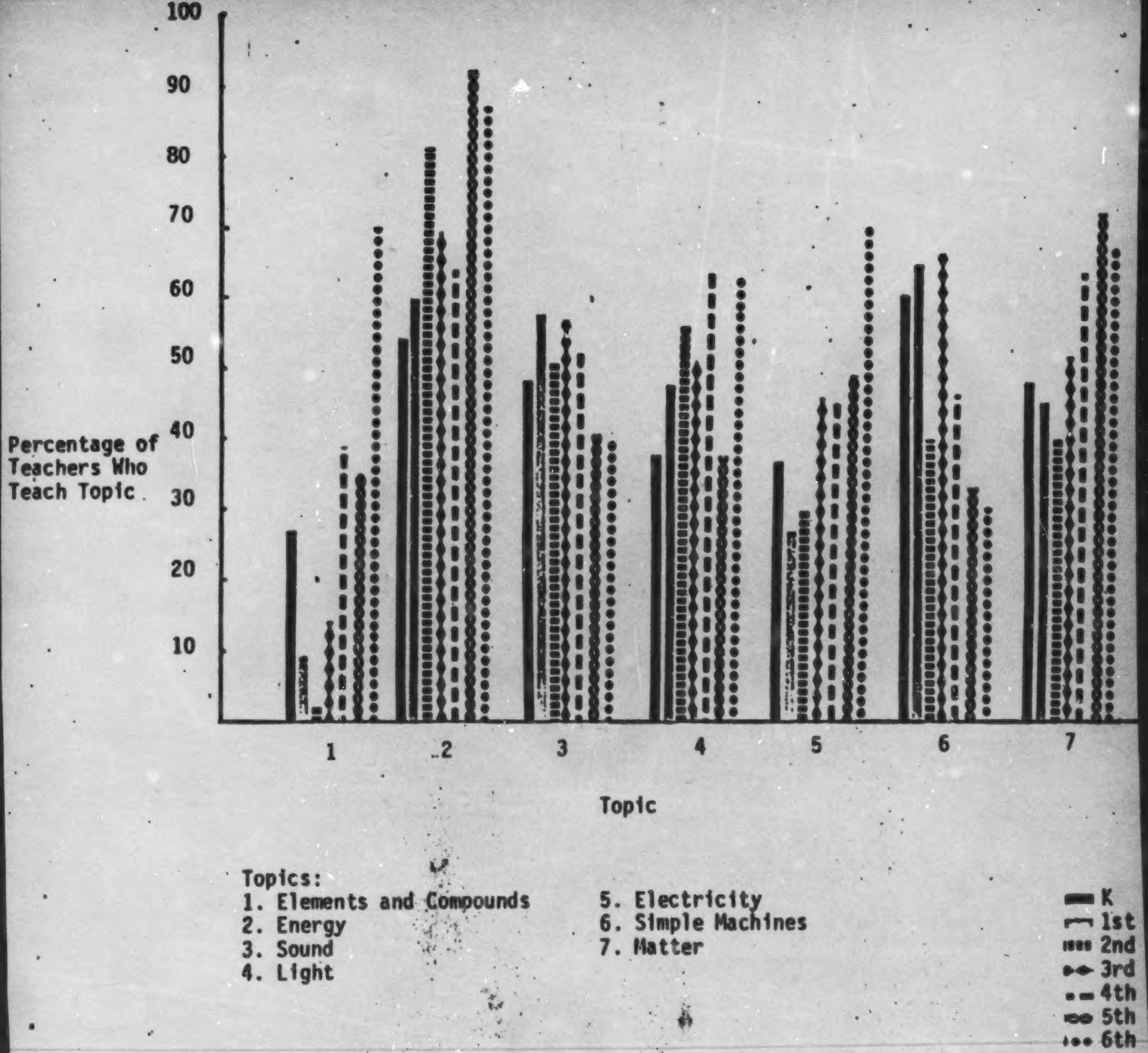


Figure 13. Physical science topics taught according to grade.

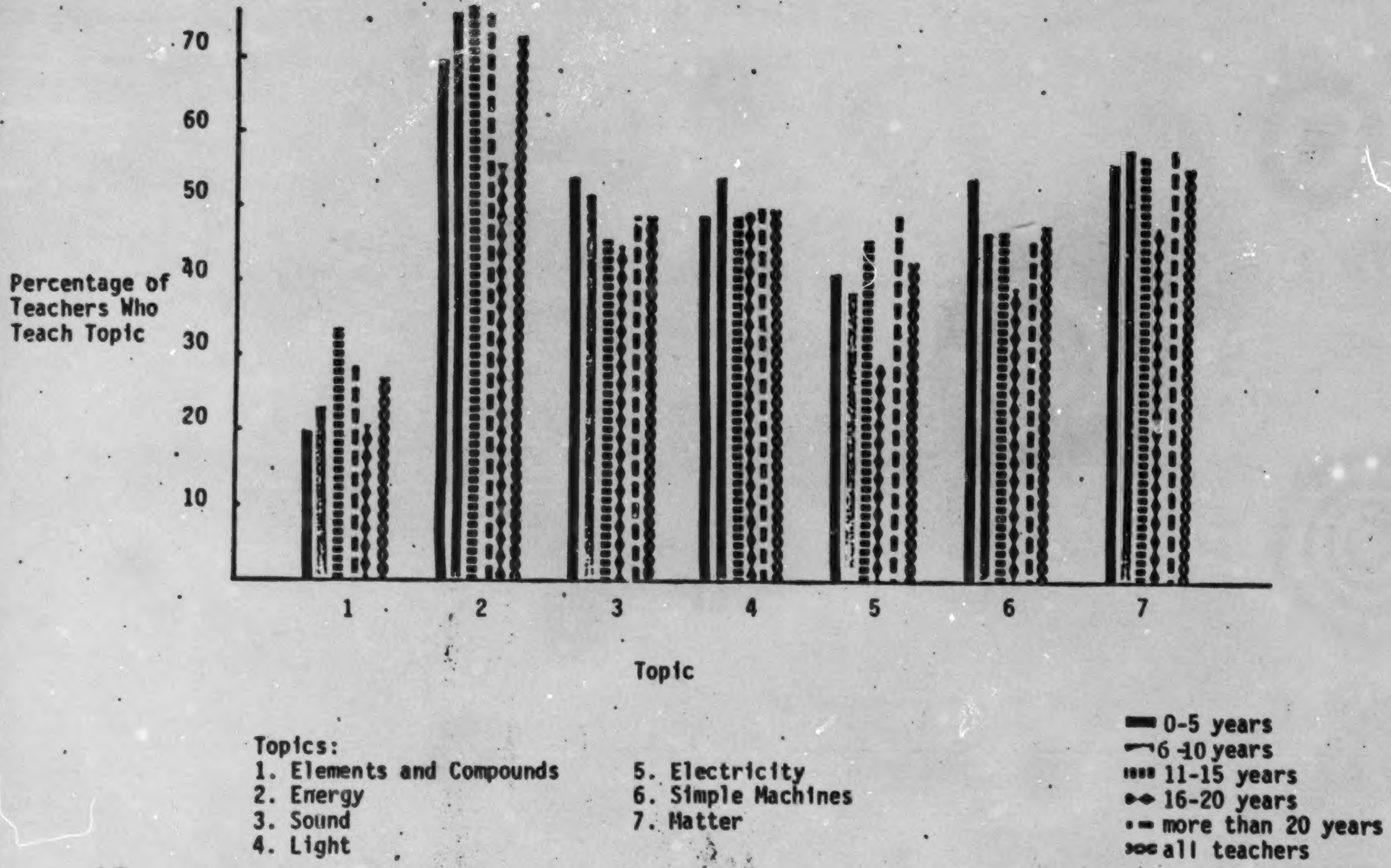


Figure 14. Physical science topics taught by teachers of various years of teaching experience.

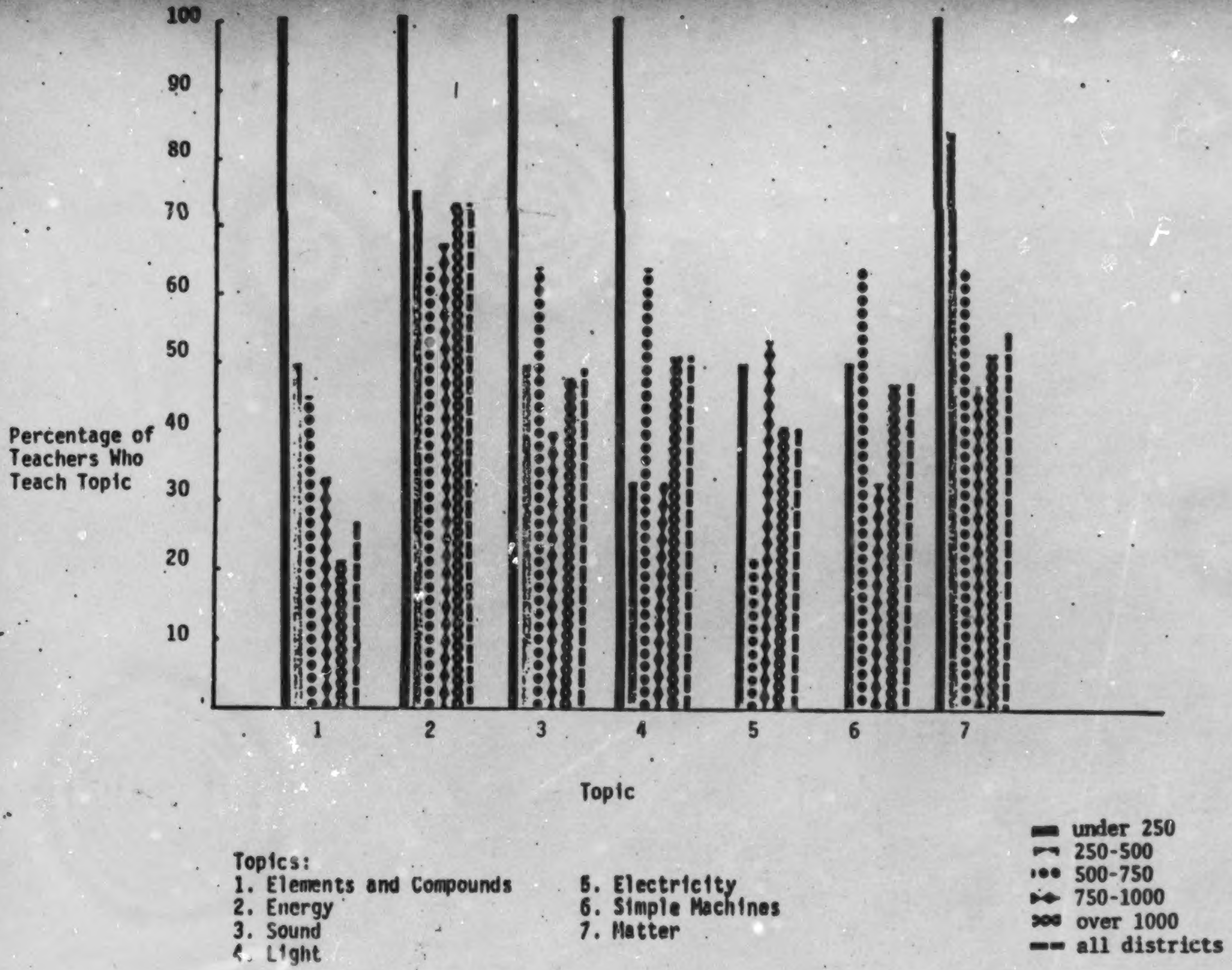


Figure 15. Physical science topics taught according to school district size.

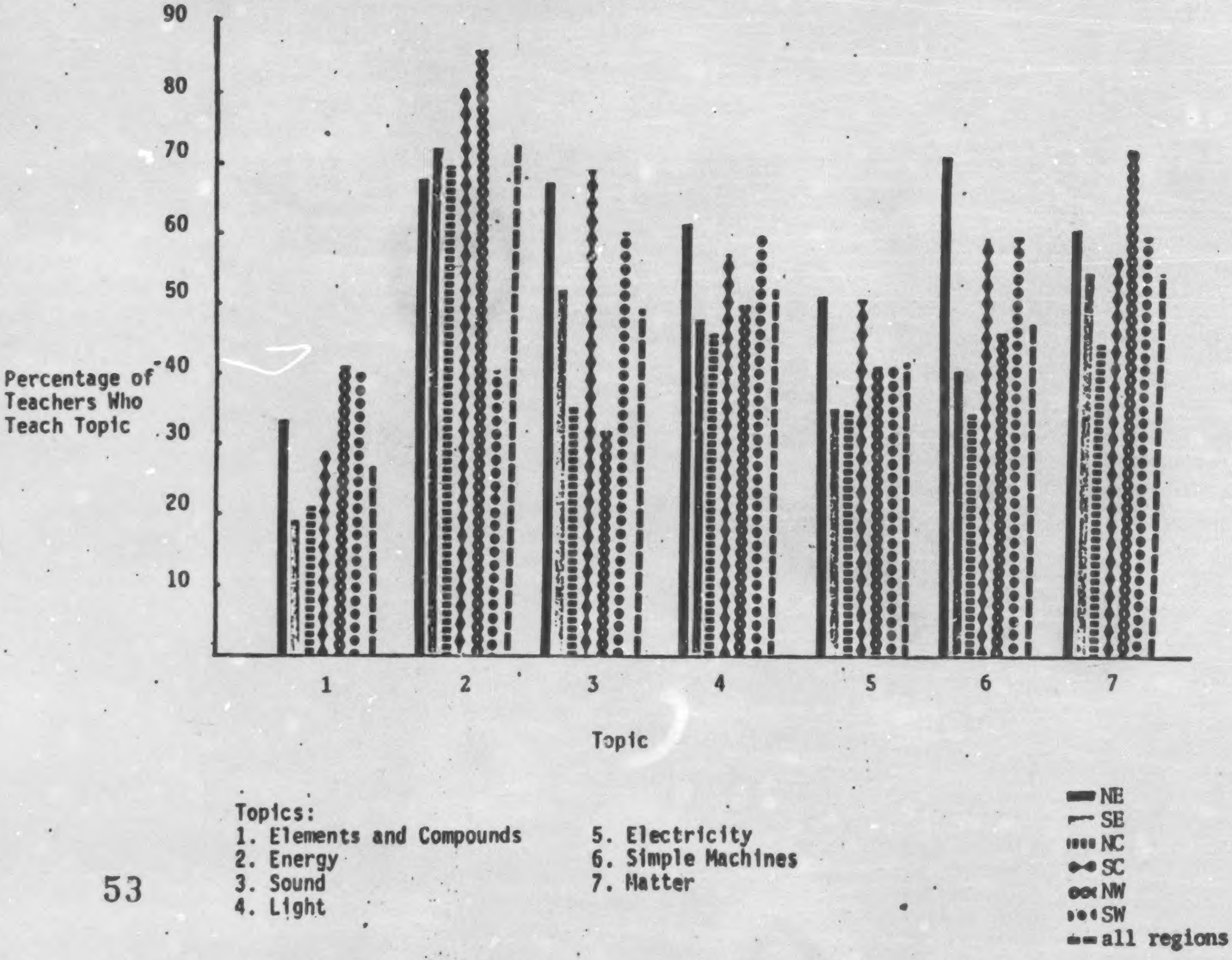


Figure 16. Physical science topics taught in different geographic regions in the U.S.

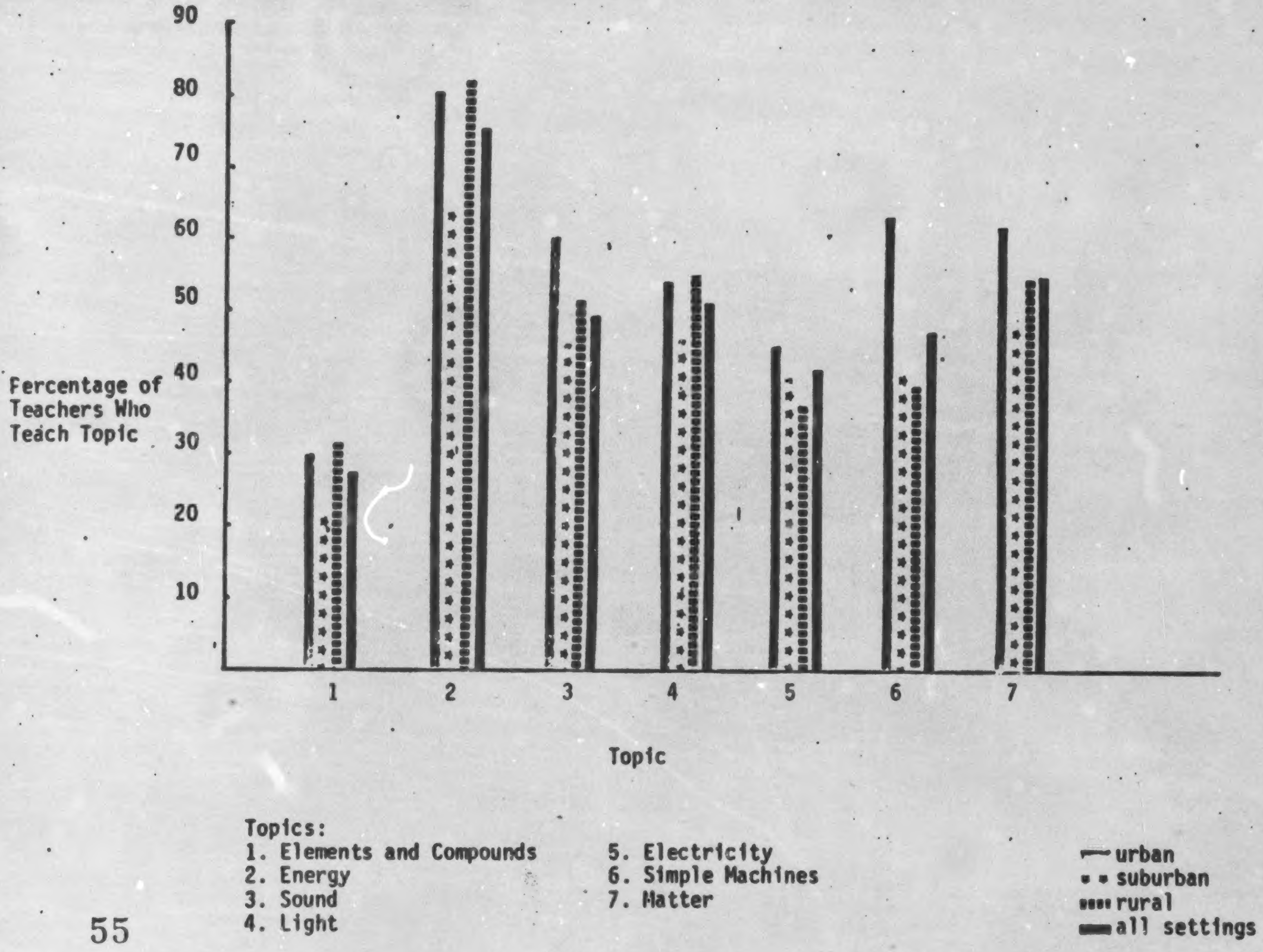


Figure 17. Physical science topics taught in different types of residential settings.

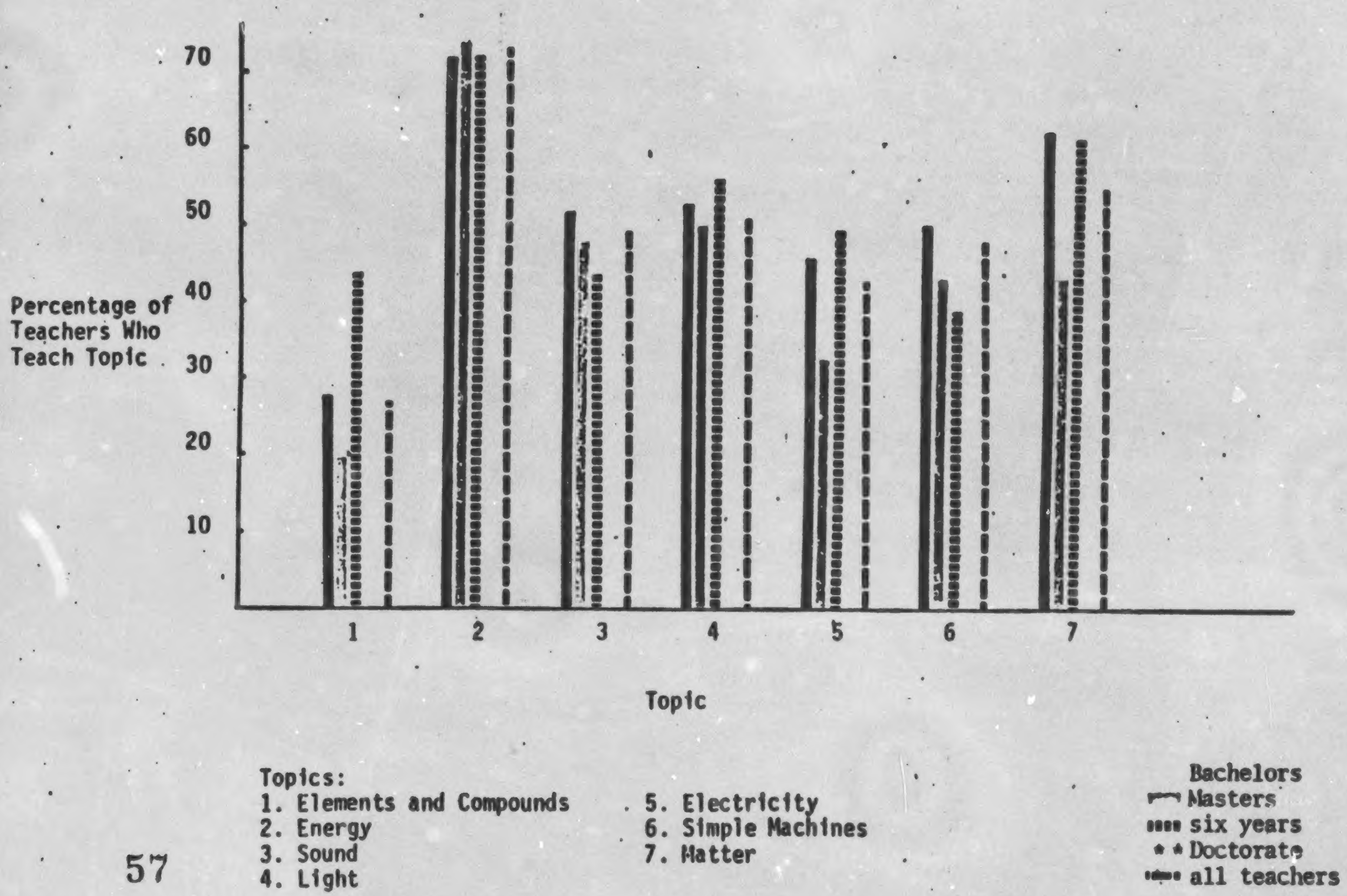
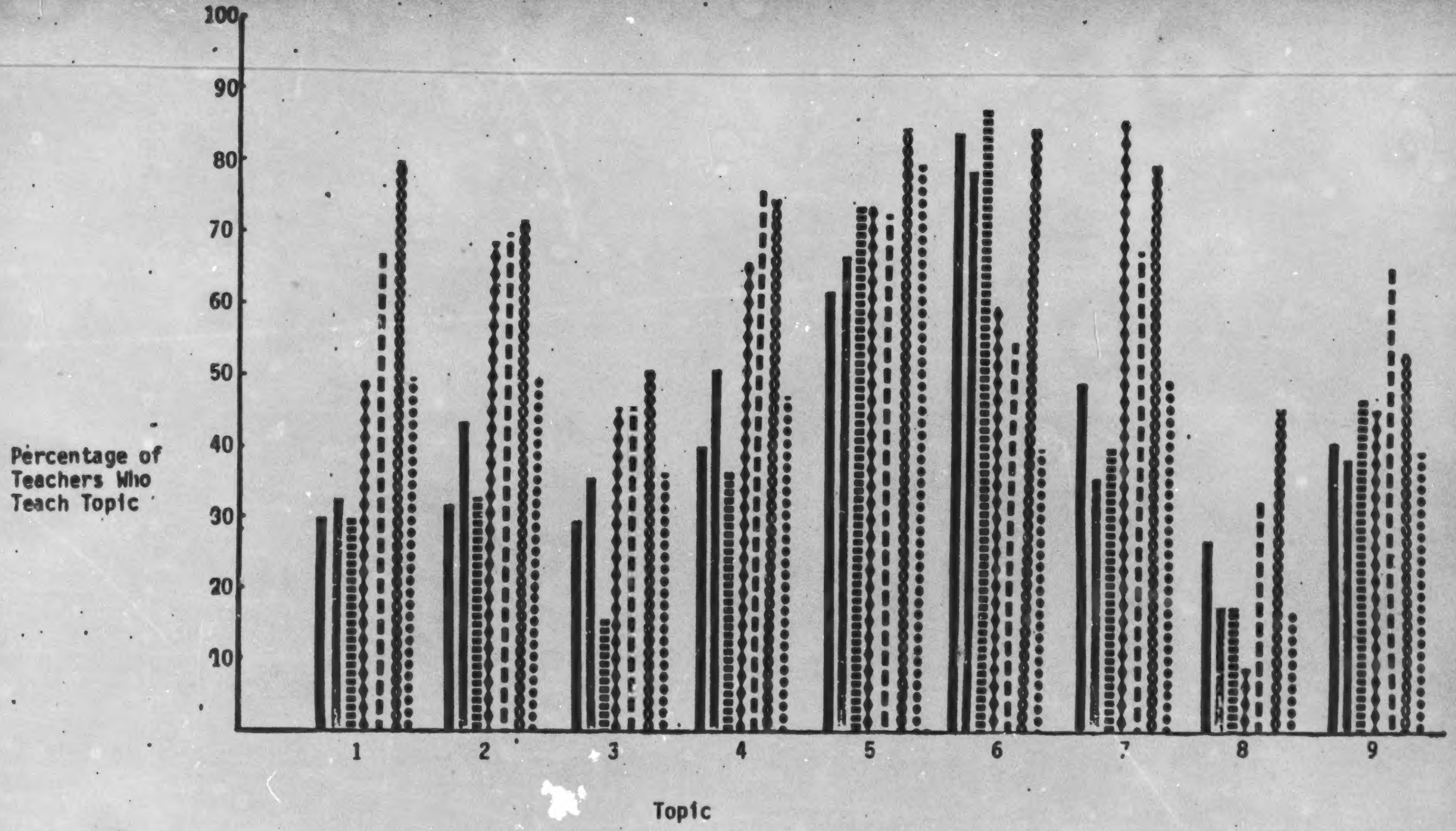


Figure 18. Physical science topics taught by teachers of various academic backgrounds.



Topics:
1. Geological Changes
2. Stars and Constellations
3. Aerospace Exploration
4. Rocks, Minerals, Soil
5. Environmental Education
6. Weather
7. Solar System
8. Oceanography
9. Fossils

Figure 19. Earth science topics taught according to grade.

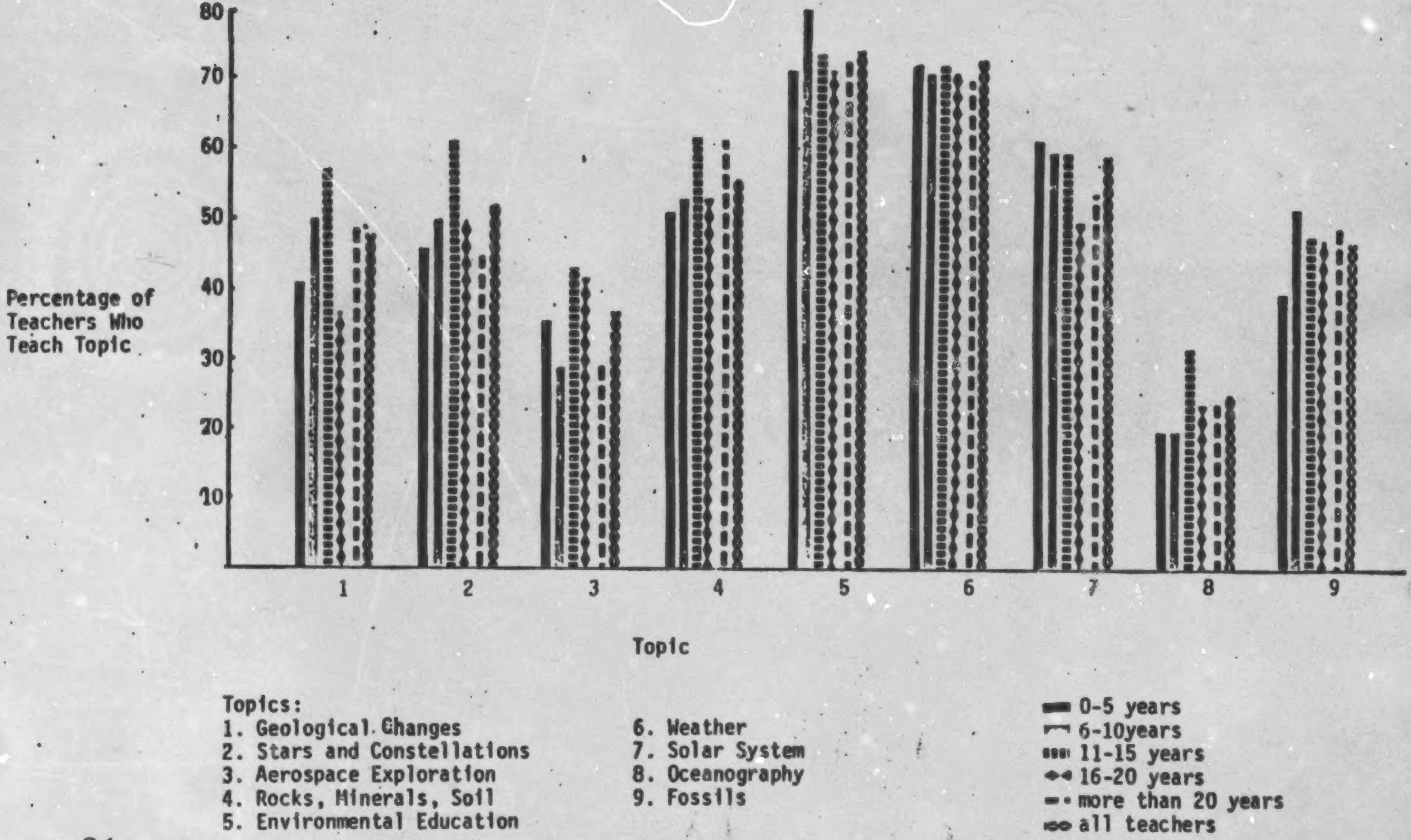


Figure 20. Earth science topics taught by teachers of various years of teaching experience.

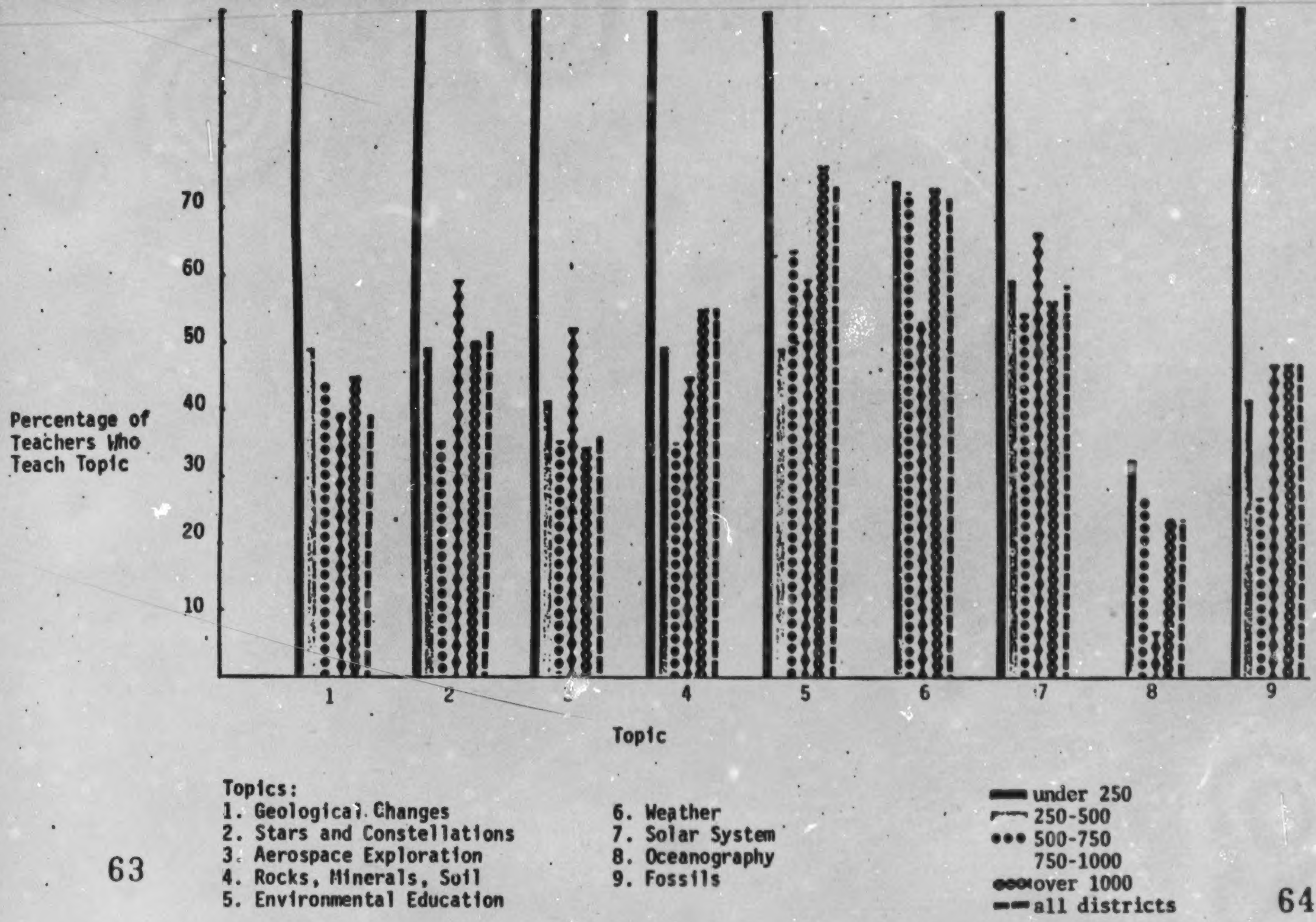


Figure 21. Earth science topics taught according to school district size.

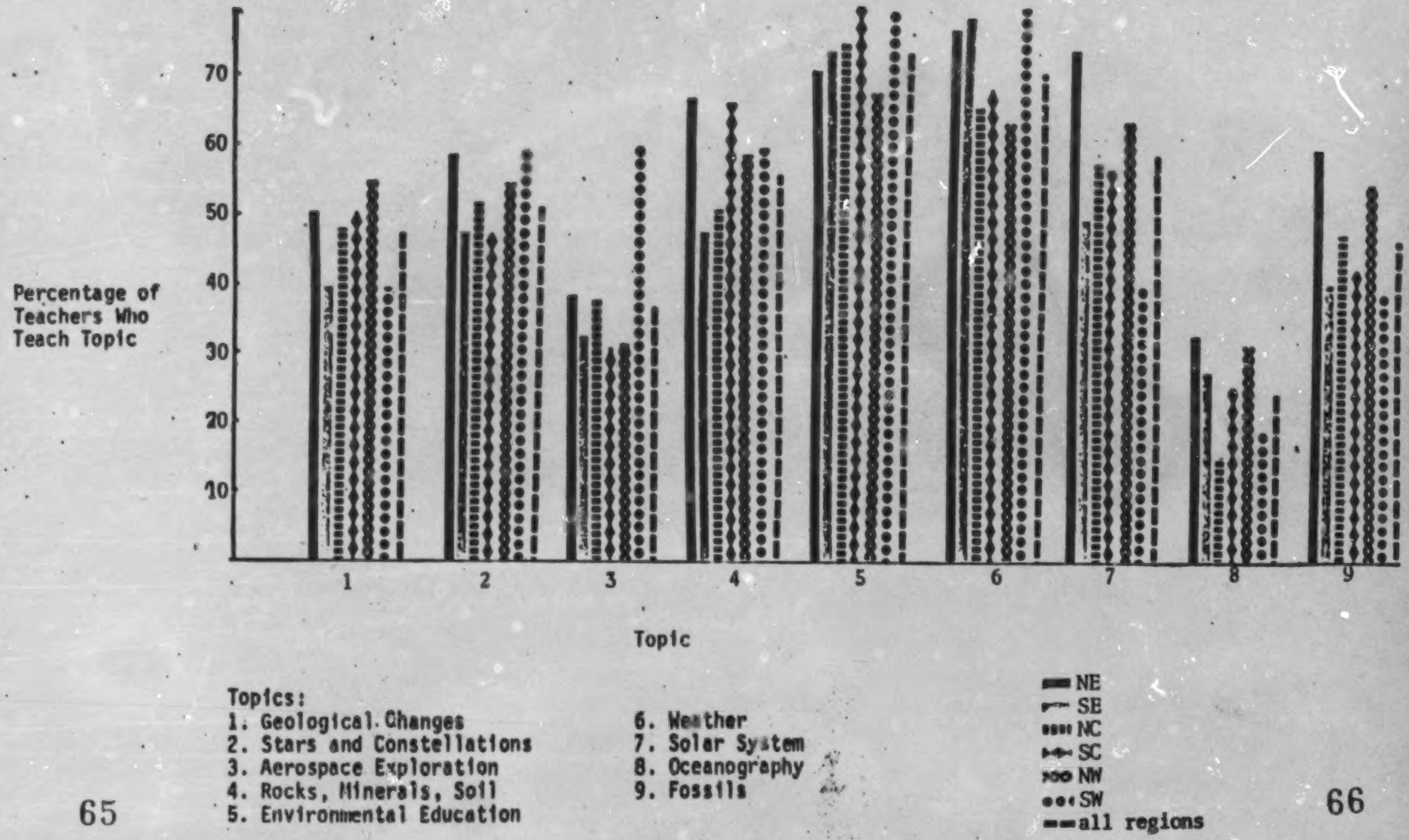
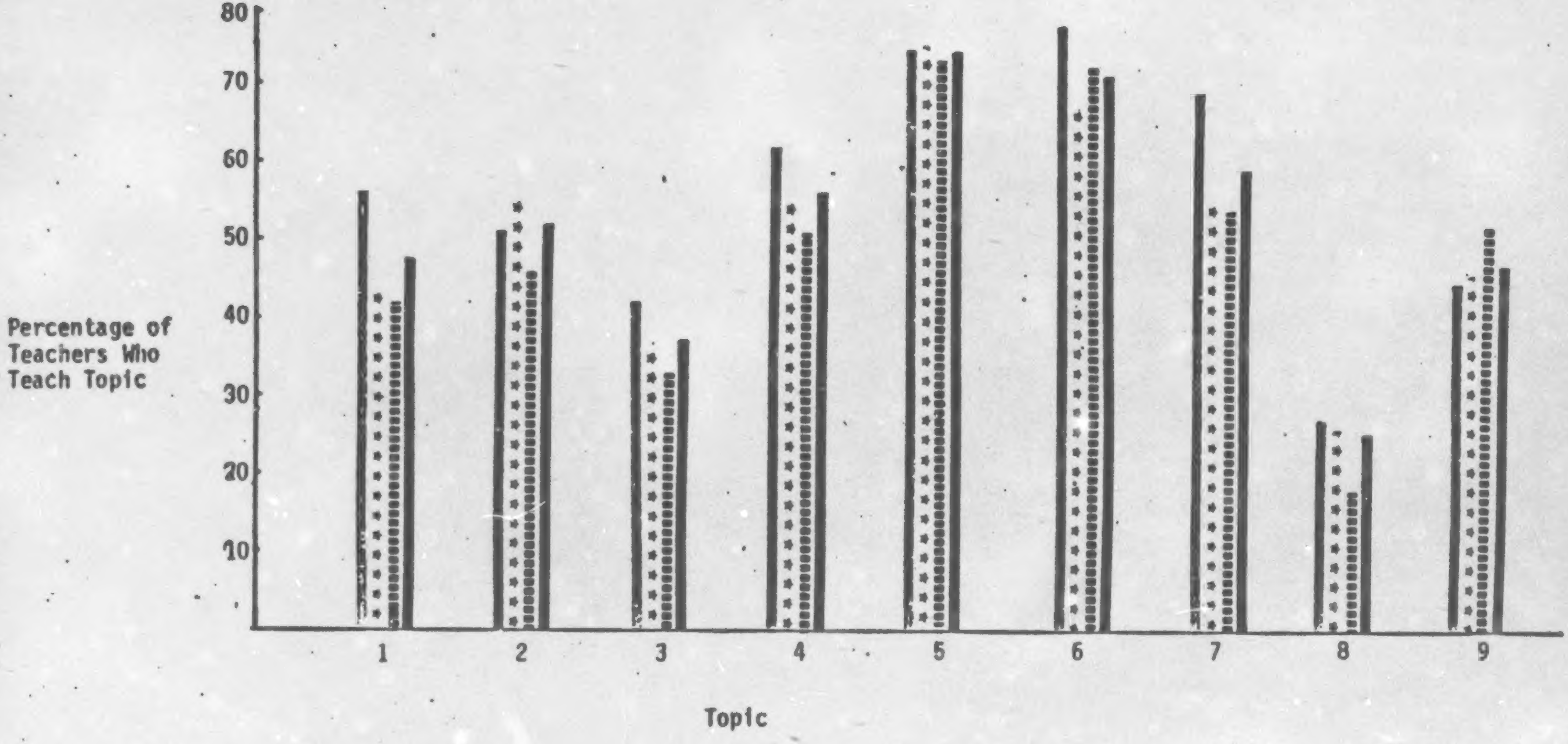


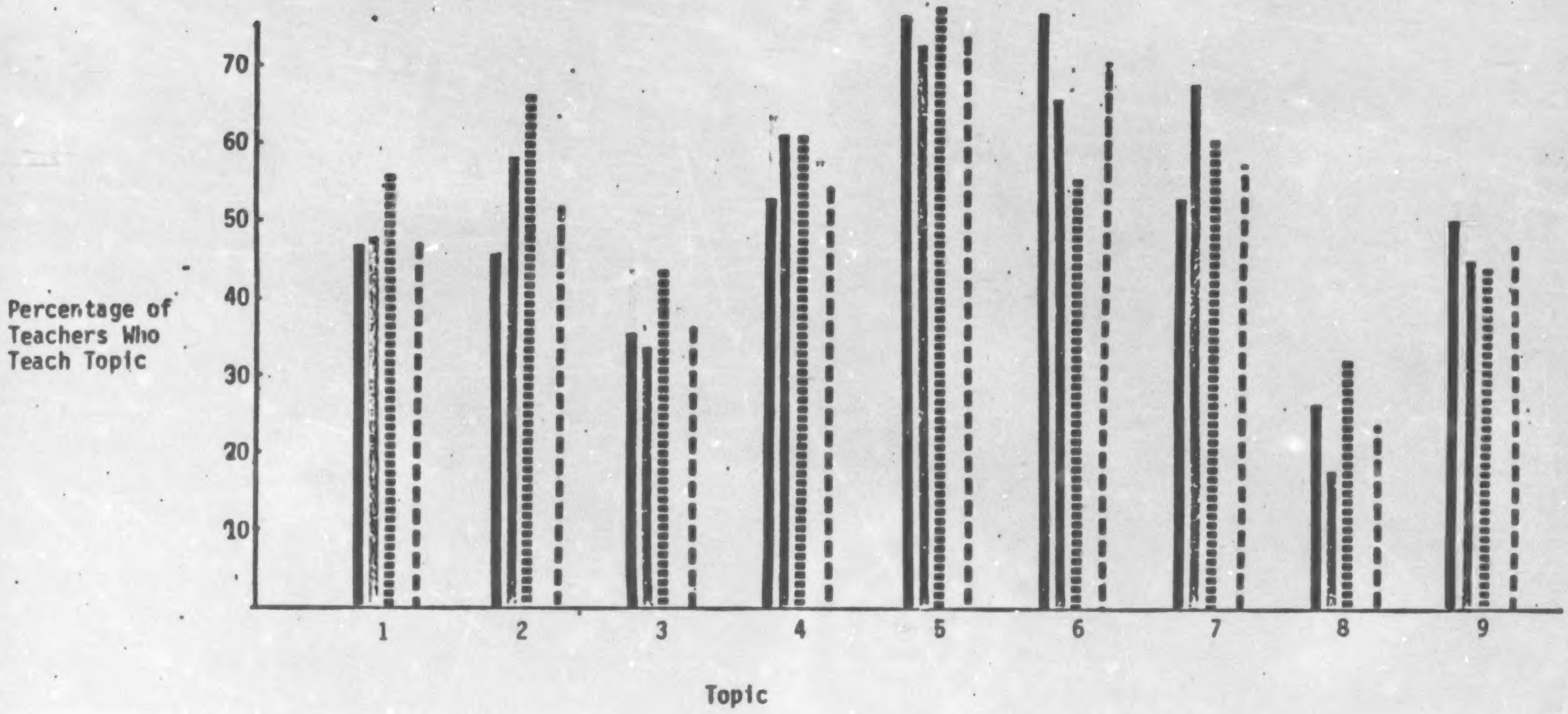
Figure 22. Earth science topics taught in different geographic regions in the U.S.



Topics:
1. Geological Changes
2. Stars and Constellations
3. Aerospace Exploration
4. Rudks, Minerals, Soil
5. Environmental Education
6. Weather
7. Solar System
8. Oceanography
9. Fossils

▬ urban
* * suburban
▪▪▪▪ rural
▬ all settings

Figure 23. Earth science topics taught in different types of residential settings.



Topics:
1. Geological Changes
2. Stars and Constellations
3. Aerospace Exploration
4. Rocks, Minerals, Soil
5. Environmental Education
6. Weather
7. Solar System
8. Oceanography
9. Fossils

▬ Bachelors
▬ Masters
▪▪▪ six years
* * Doctorate
- - all teachers

Figure 24. Earth science topics taught by teachers of various academic backgrounds.

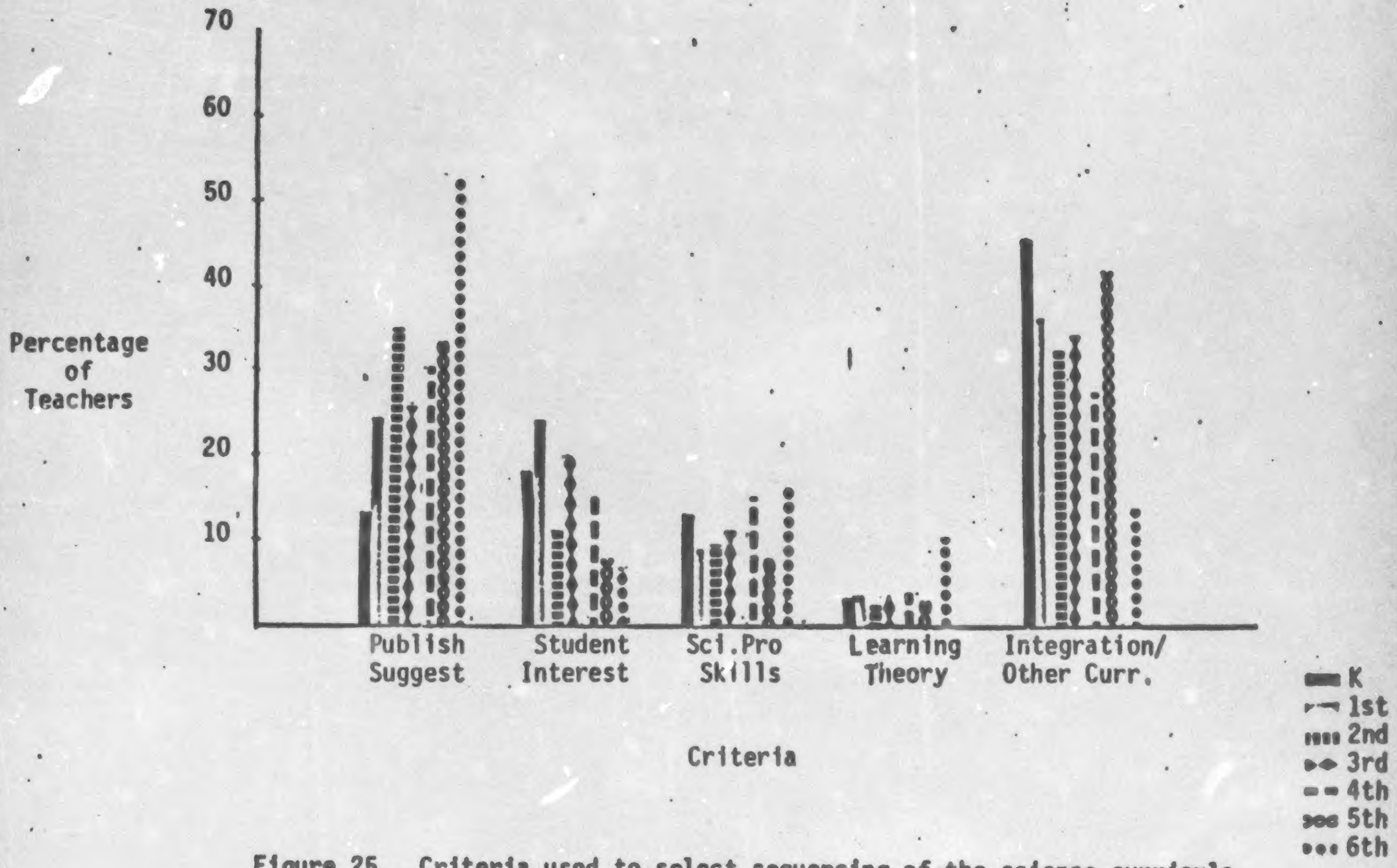


Figure 25. Criteria used to select sequencing of the science curricula according to grade taught.

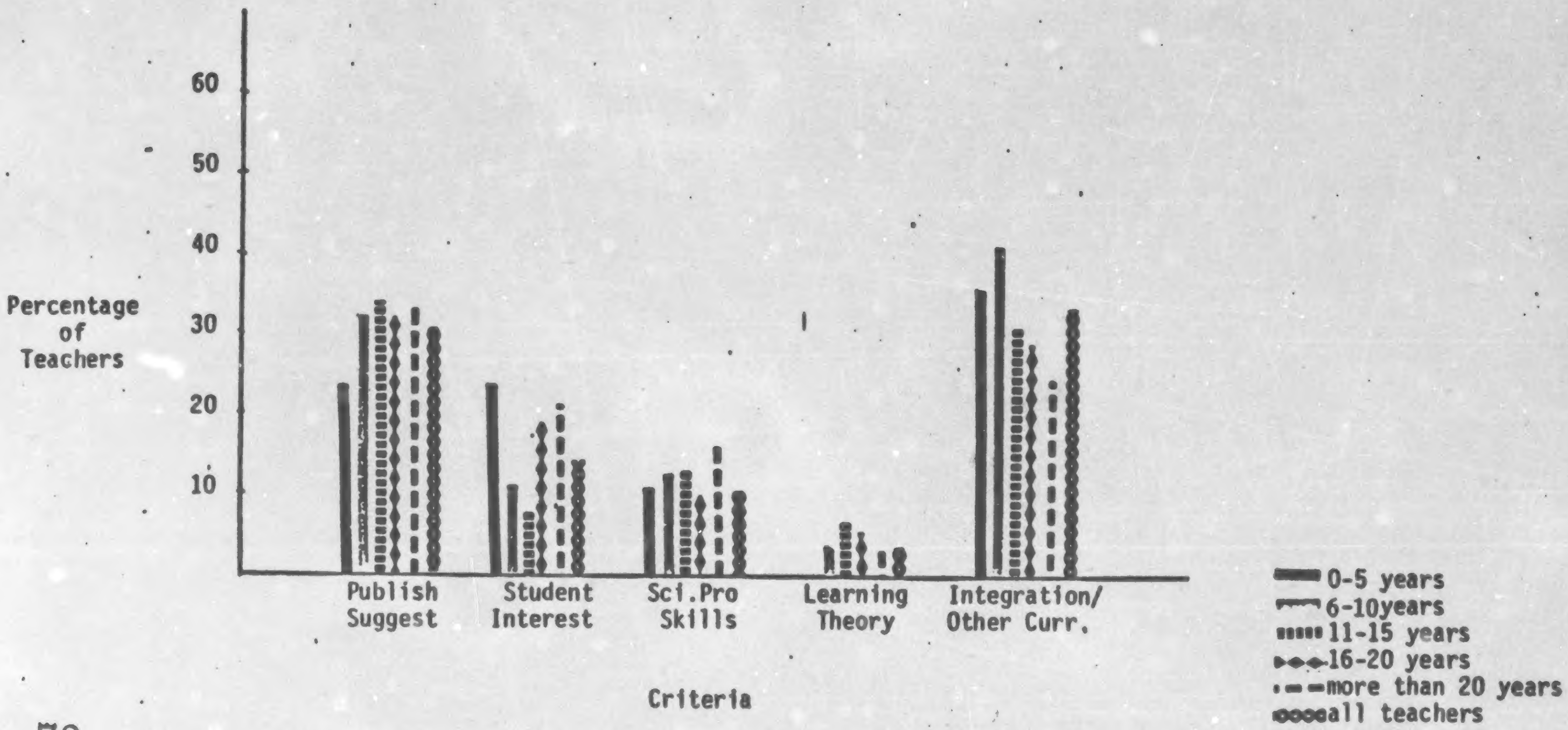


Figure 26. Criteria used to select sequencing of the science curricula as perceived by teachers of various teaching experience.

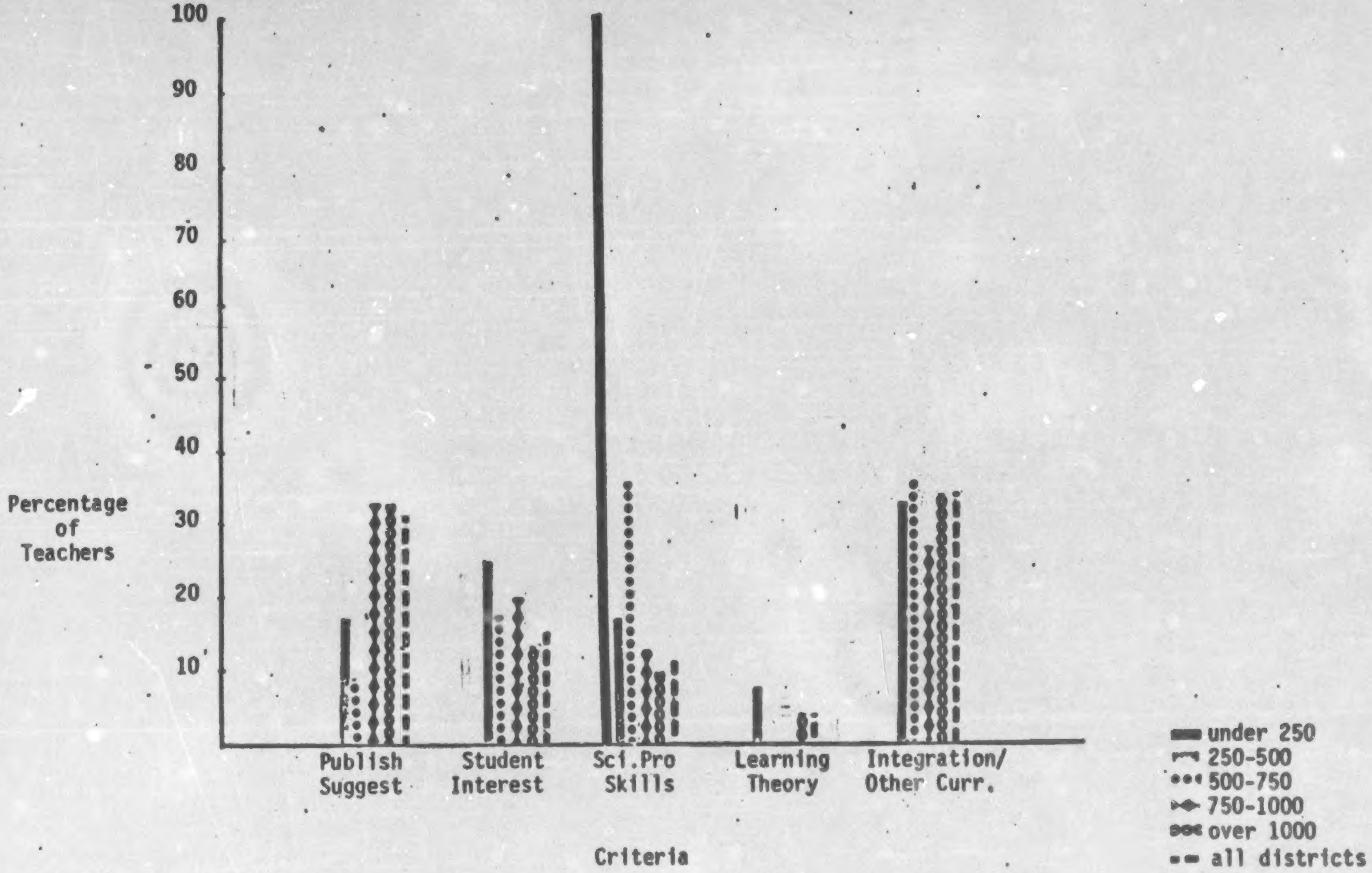


Figure 27. Criteria used to select sequencing of the science curricula as perceived by teachers of various schooldistrict size.

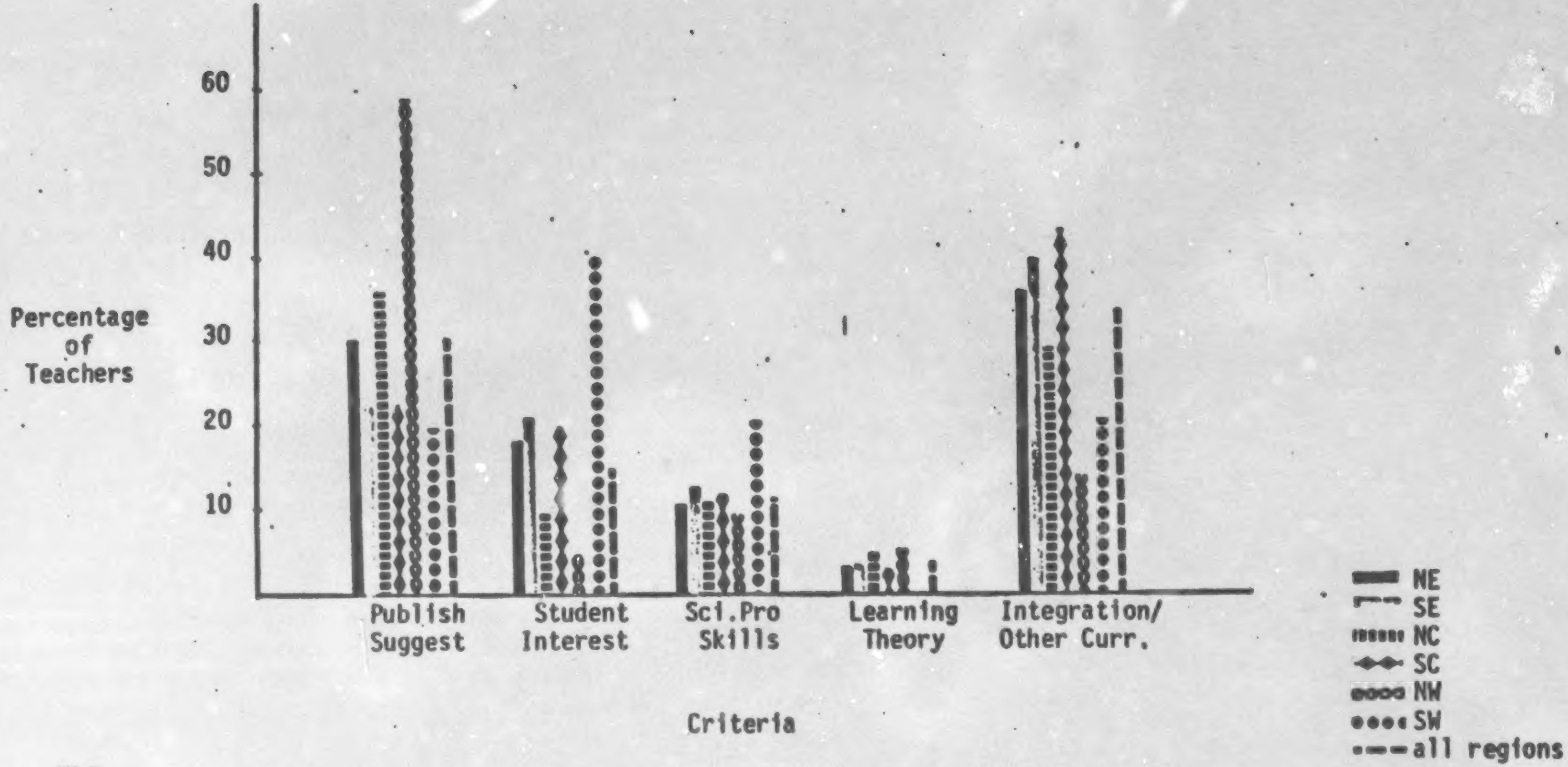


Figure 28. Criteria used to select sequencing of the science curricula as perceived by teachers in different geographic regions of the U.S.

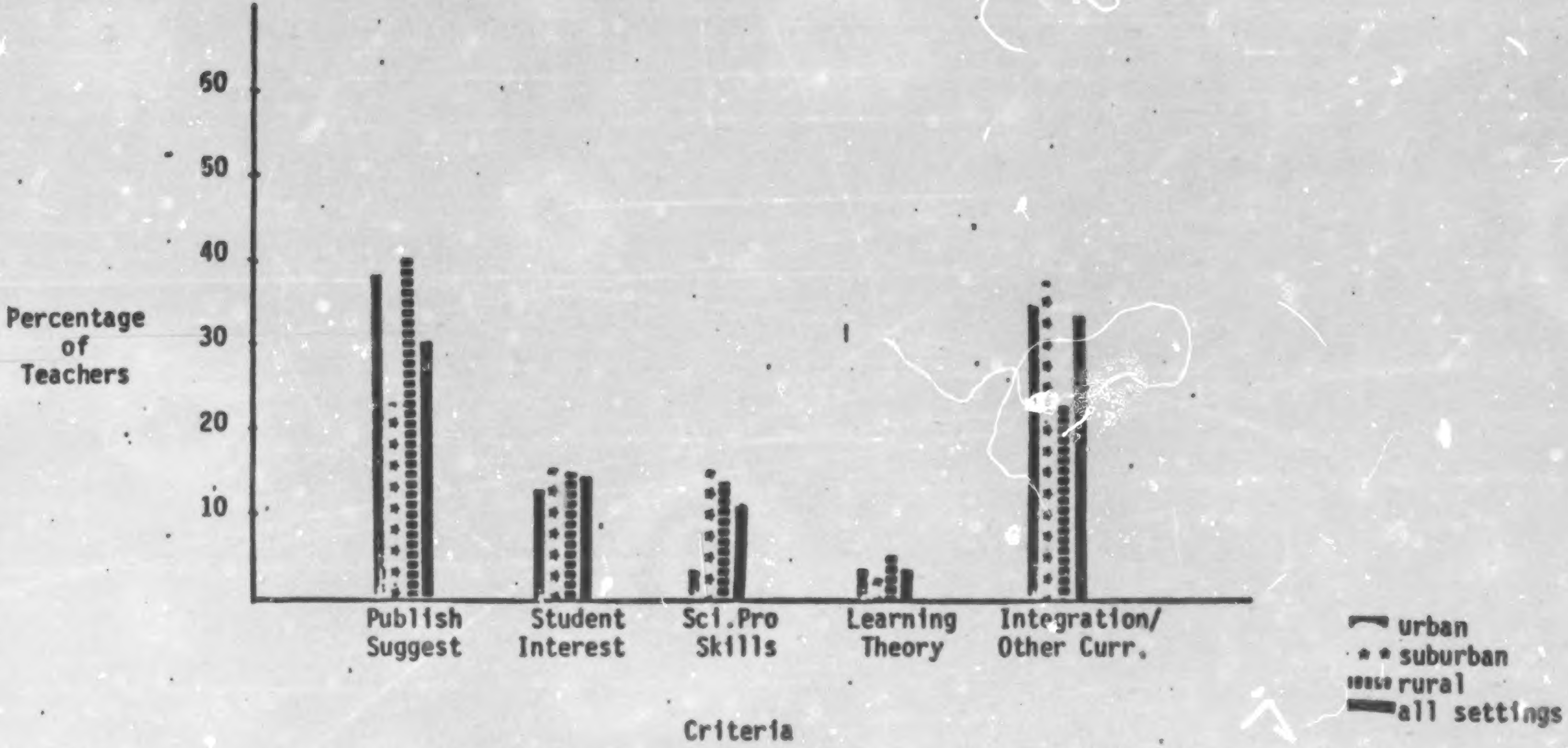


Figure 29. Criteria used to select sequencing of the science curricula as perceived by teachers in different types of residential settings.

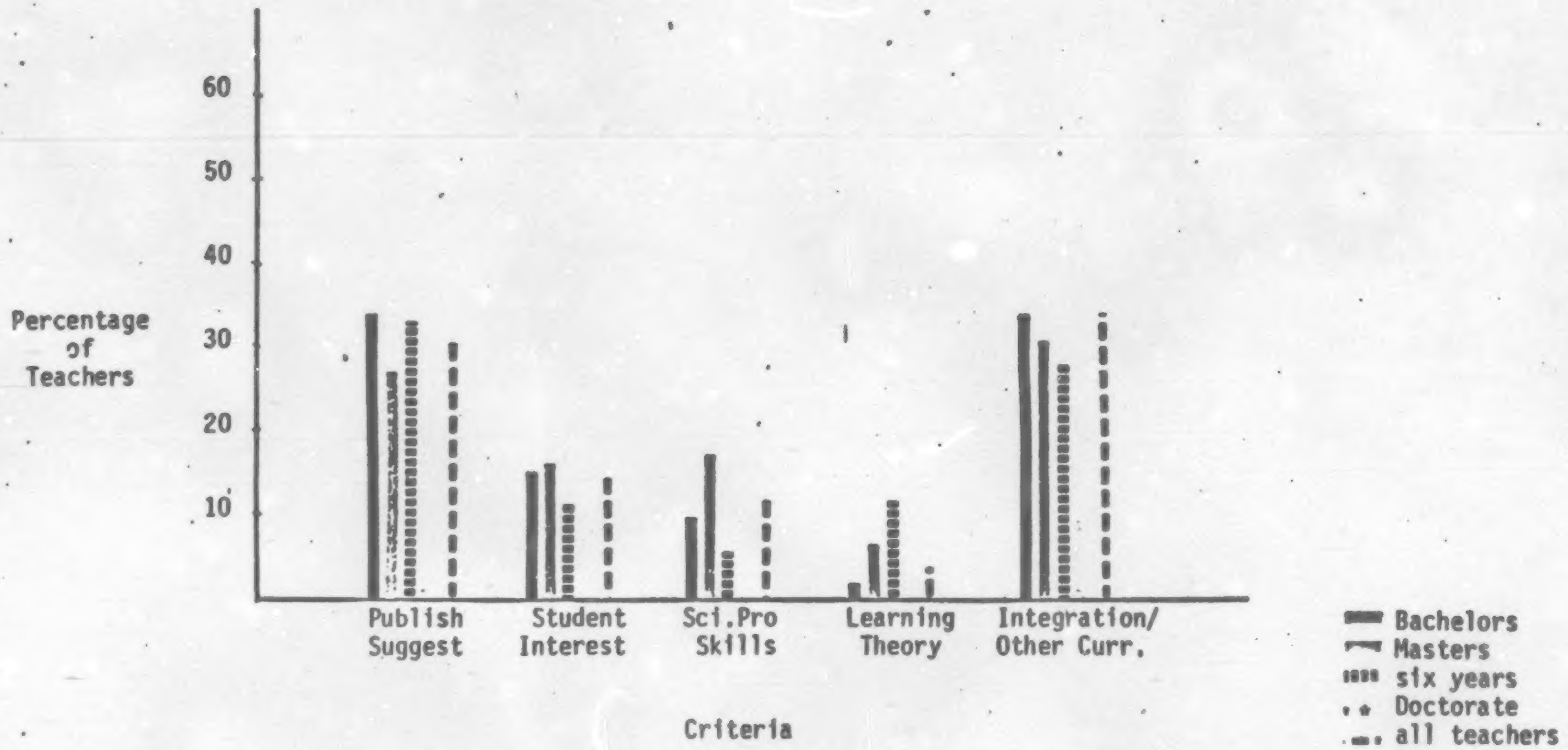


Figure 30. Criteria used to select sequencing of the science curricula as perceived by teachers of various academic backgrounds.

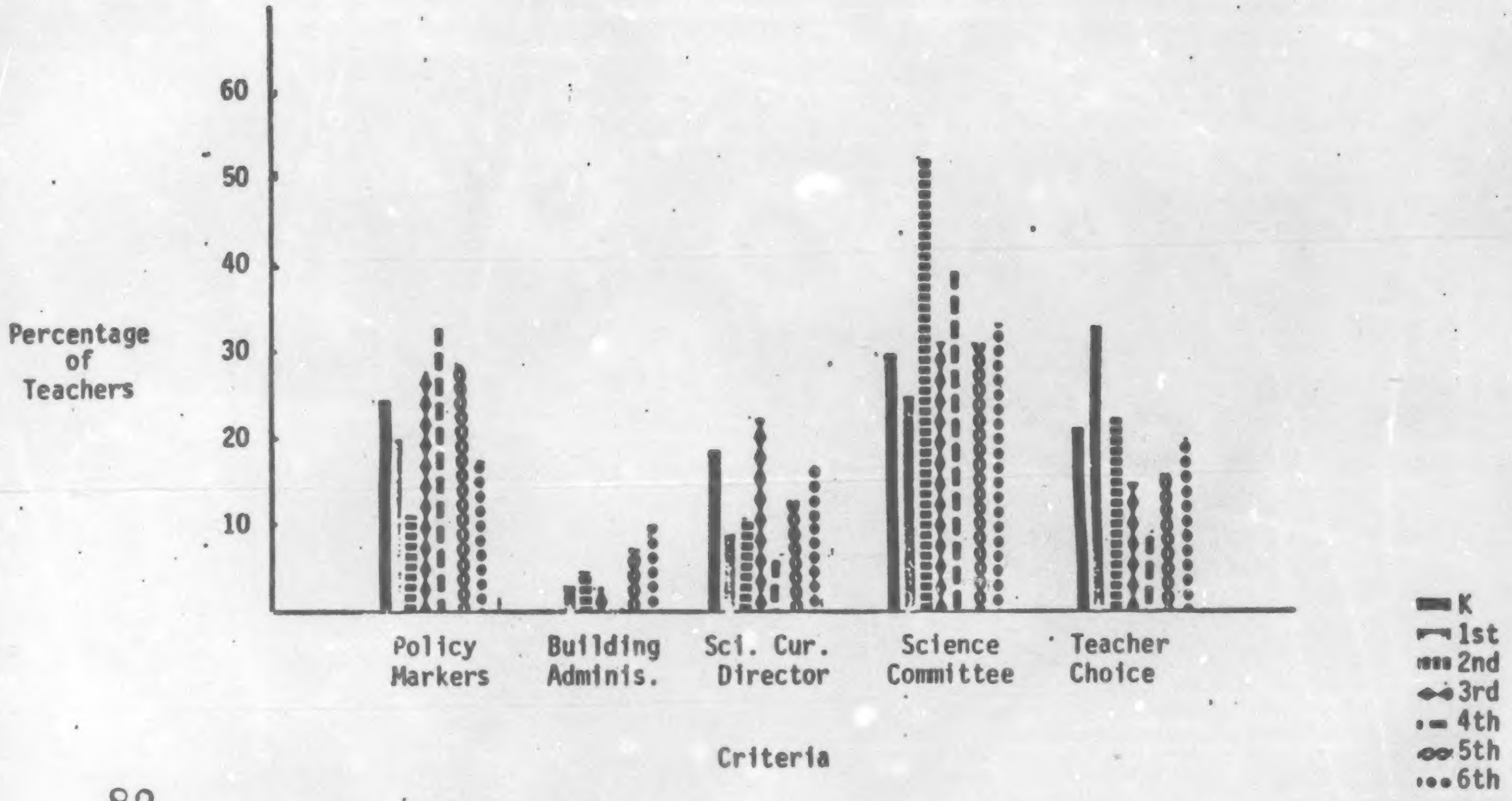


Figure 31. Groups responsible for selecting content of the science curriculum according to grade.

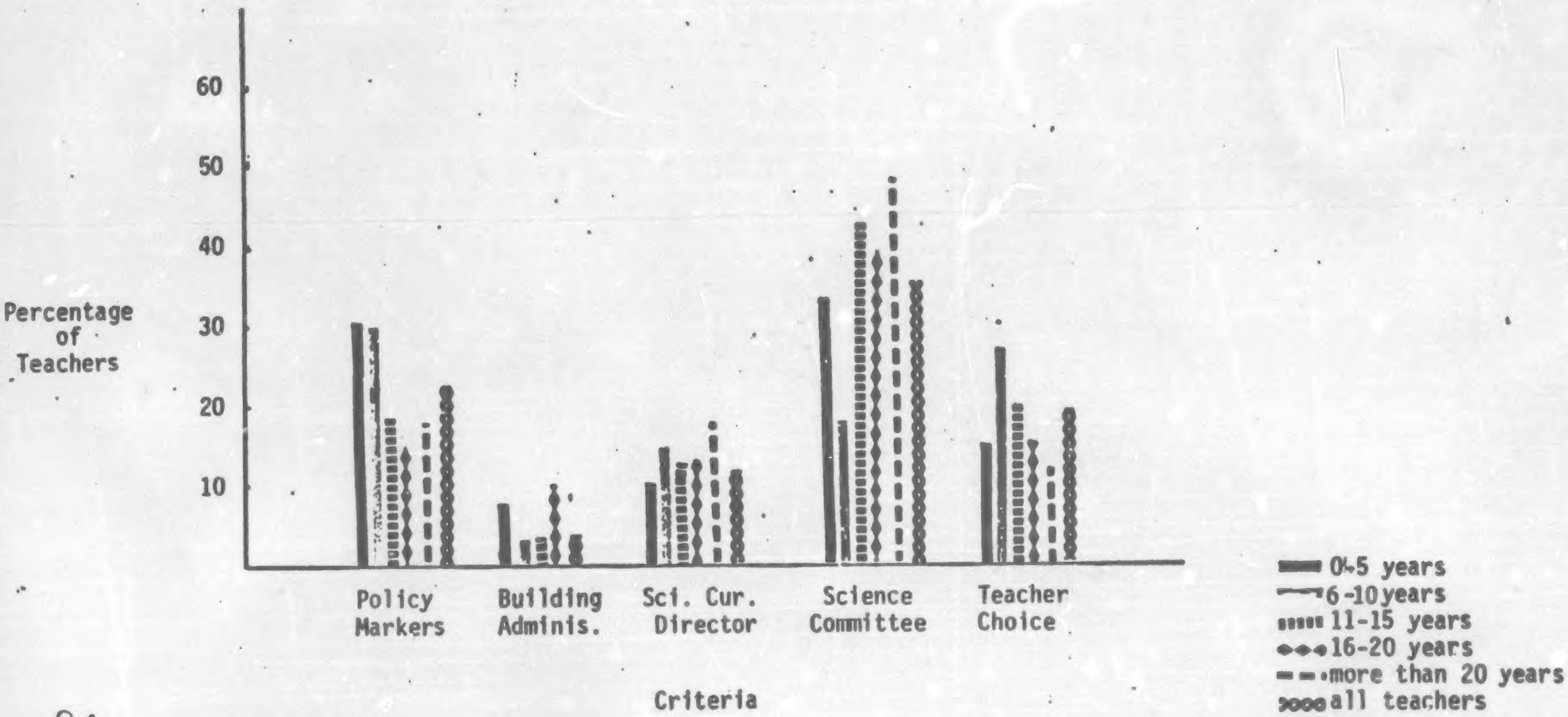


Figure 32. Groups responsible for selecting content of the science curriculum as perceived by teachers of various teaching experience.

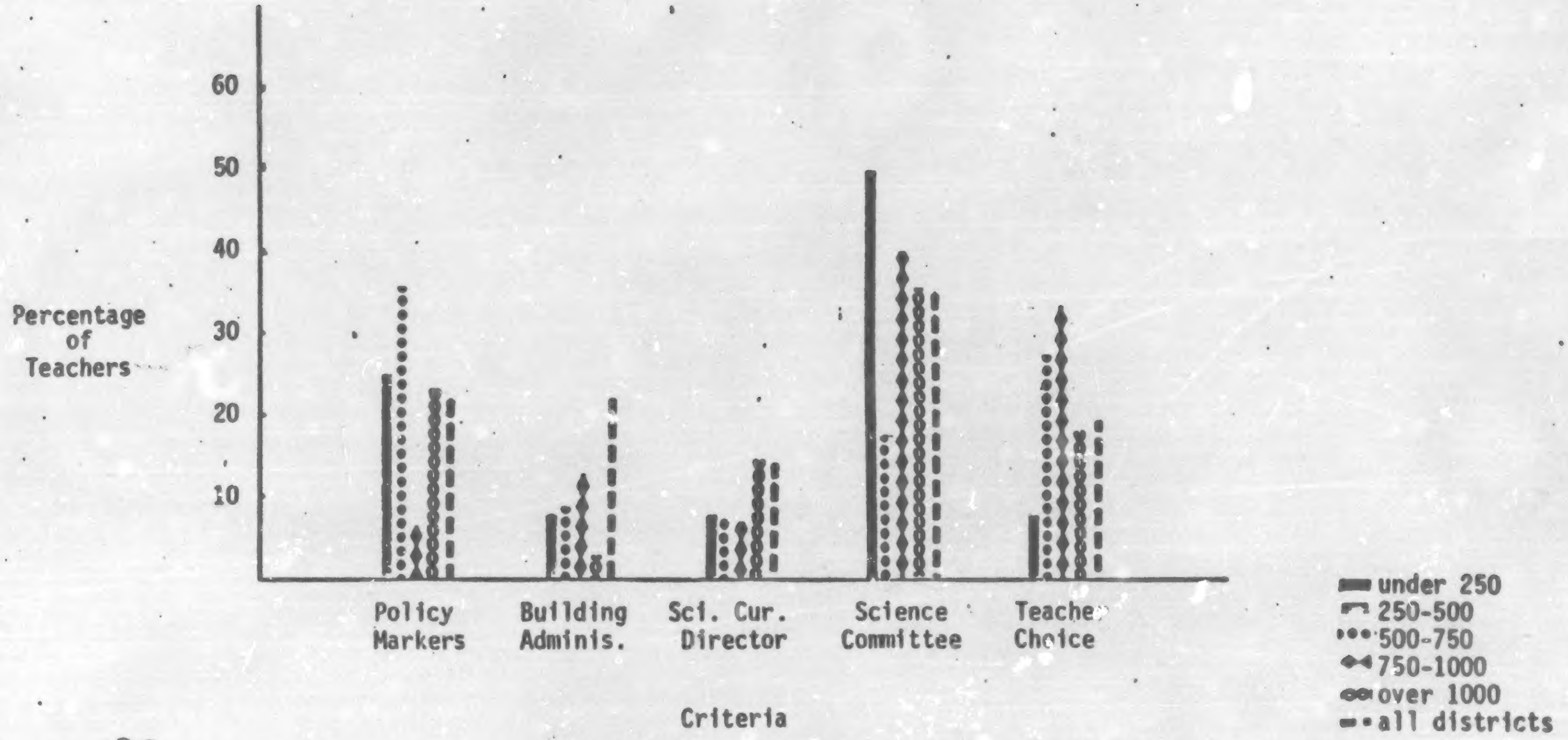


Figure 33. Groups responsible for selecting content of the science curriculum as perceived by teachers of various school district size.

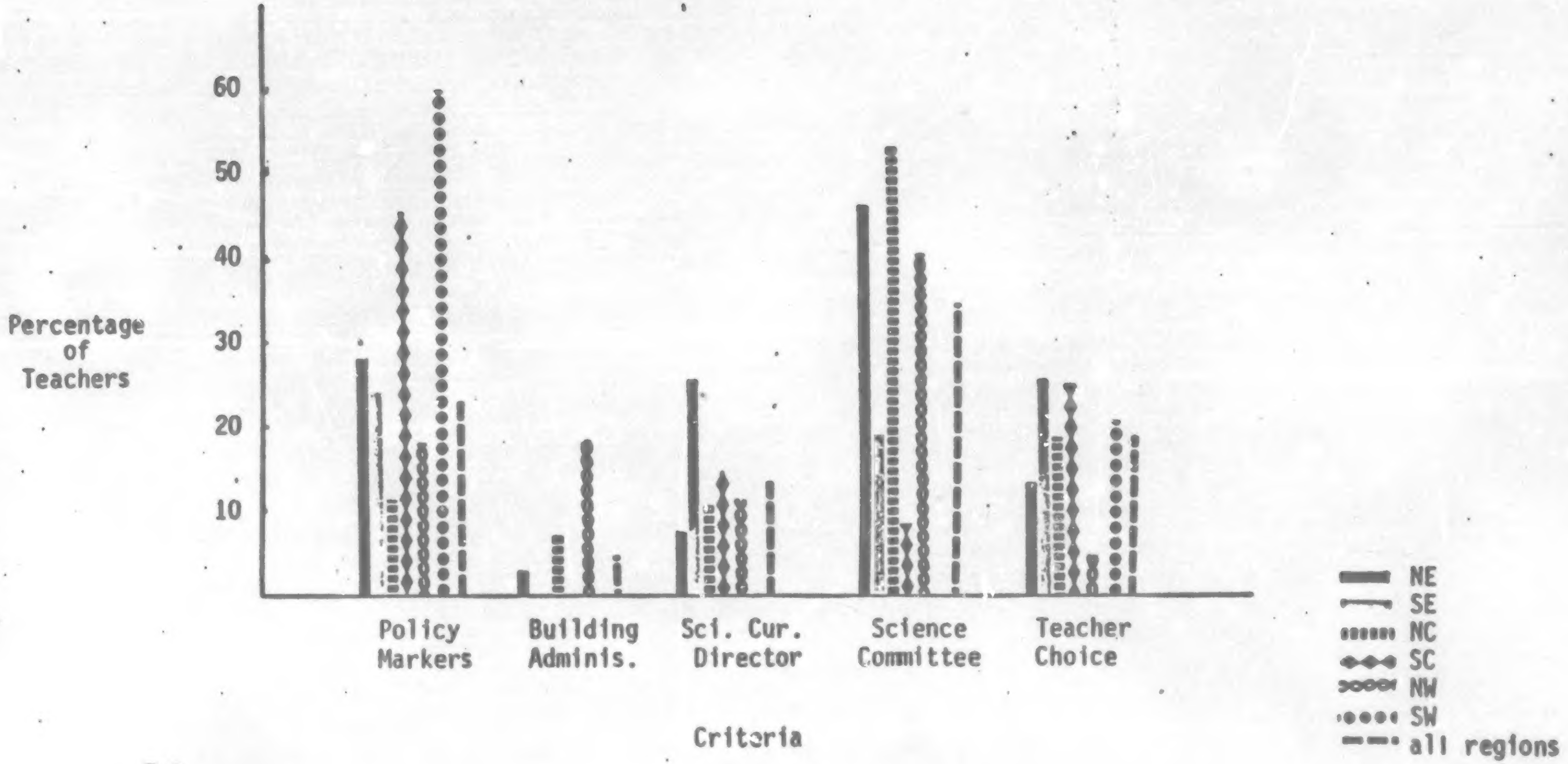


Figure 34. Groups responsible for selecting content of the science curriculum as perceived by teachers in different geographic regions of the U.S.

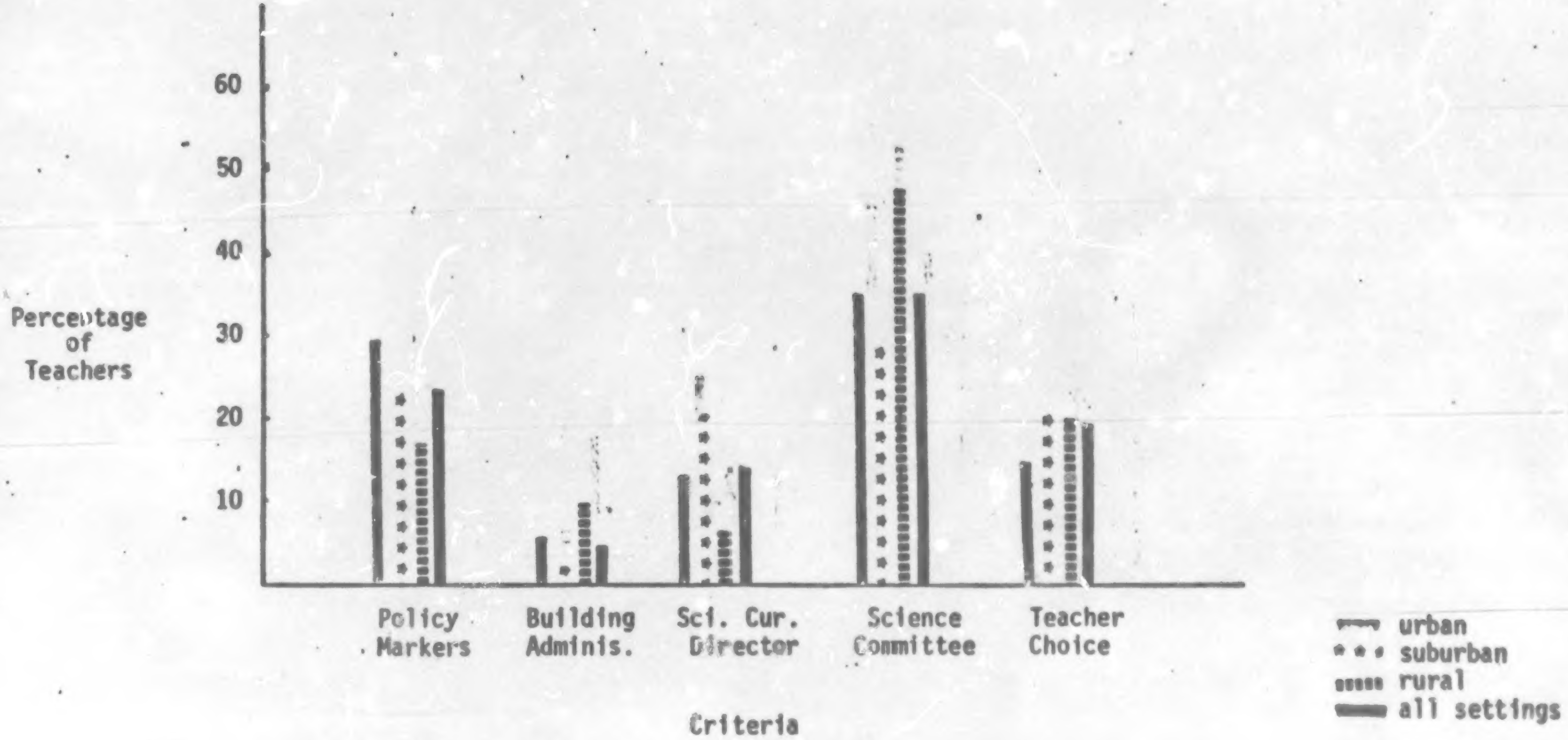


Figure 35. Groups responsible for selecting content of the science curriculum as perceived by teachers in different types of residential settings.

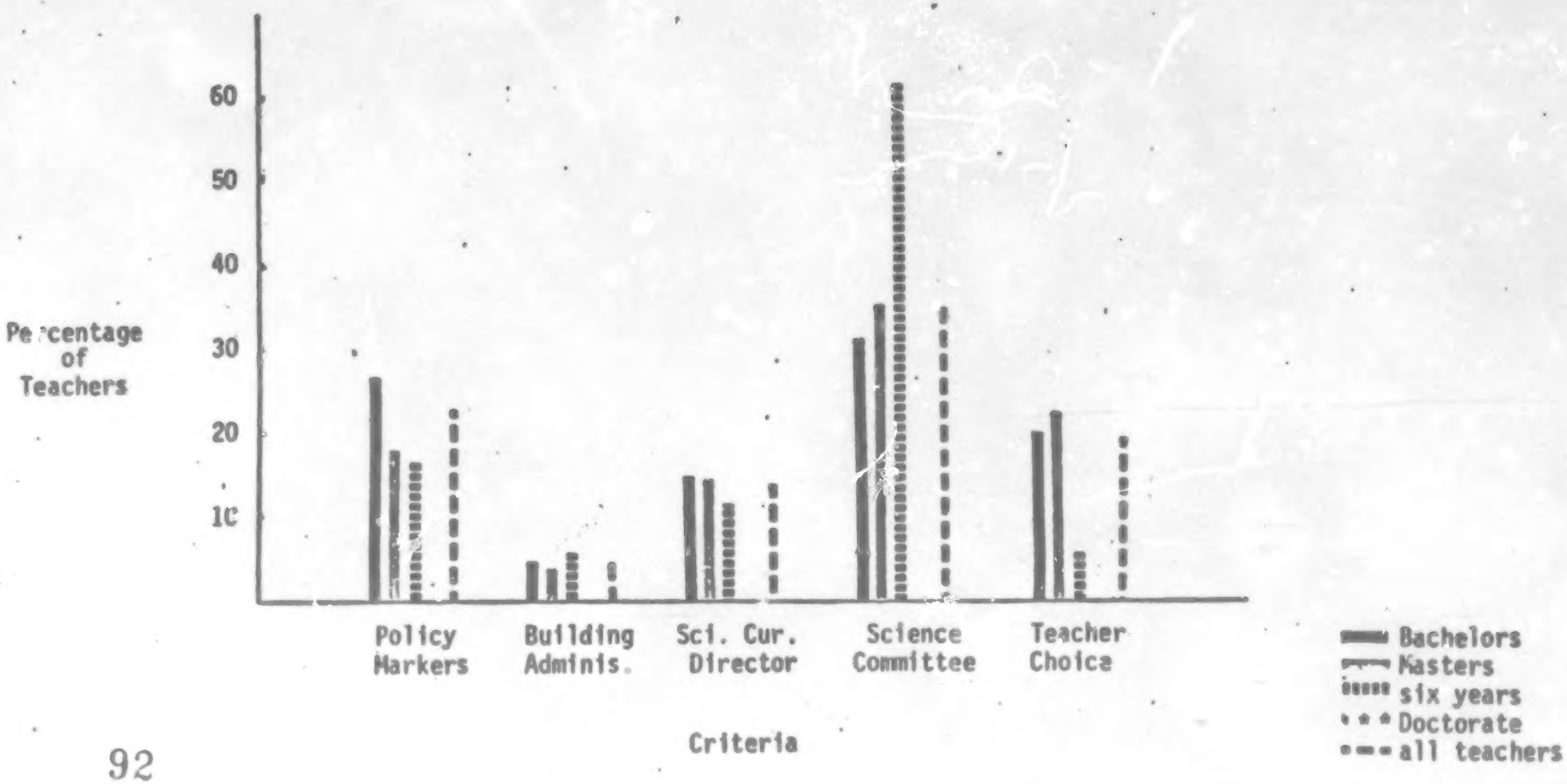


Figure 36. Groups responsible for selecting content of the science curriculum as perceived by teachers of various academic background.

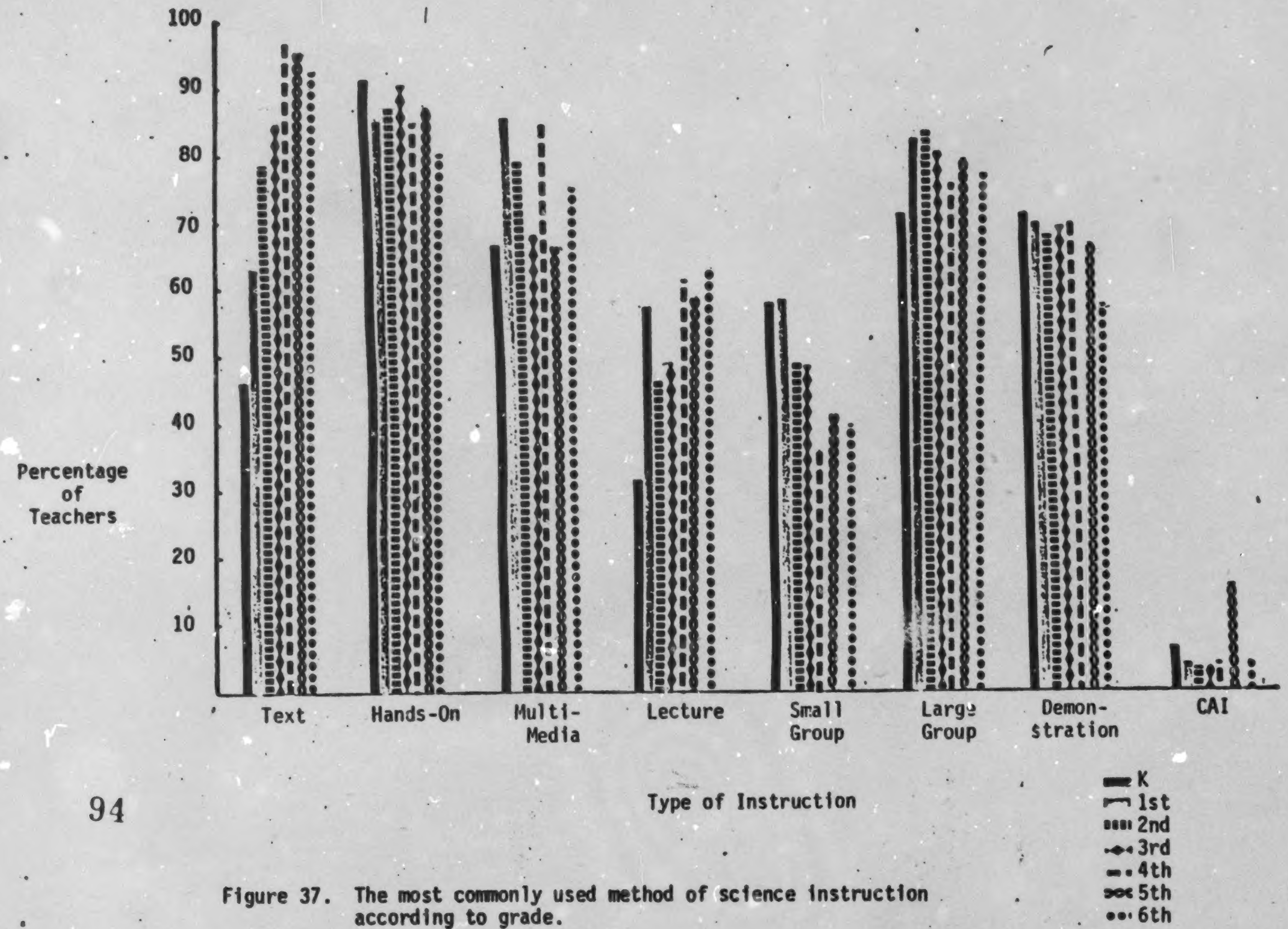


Figure 37. The most commonly used method of science instruction according to grade.

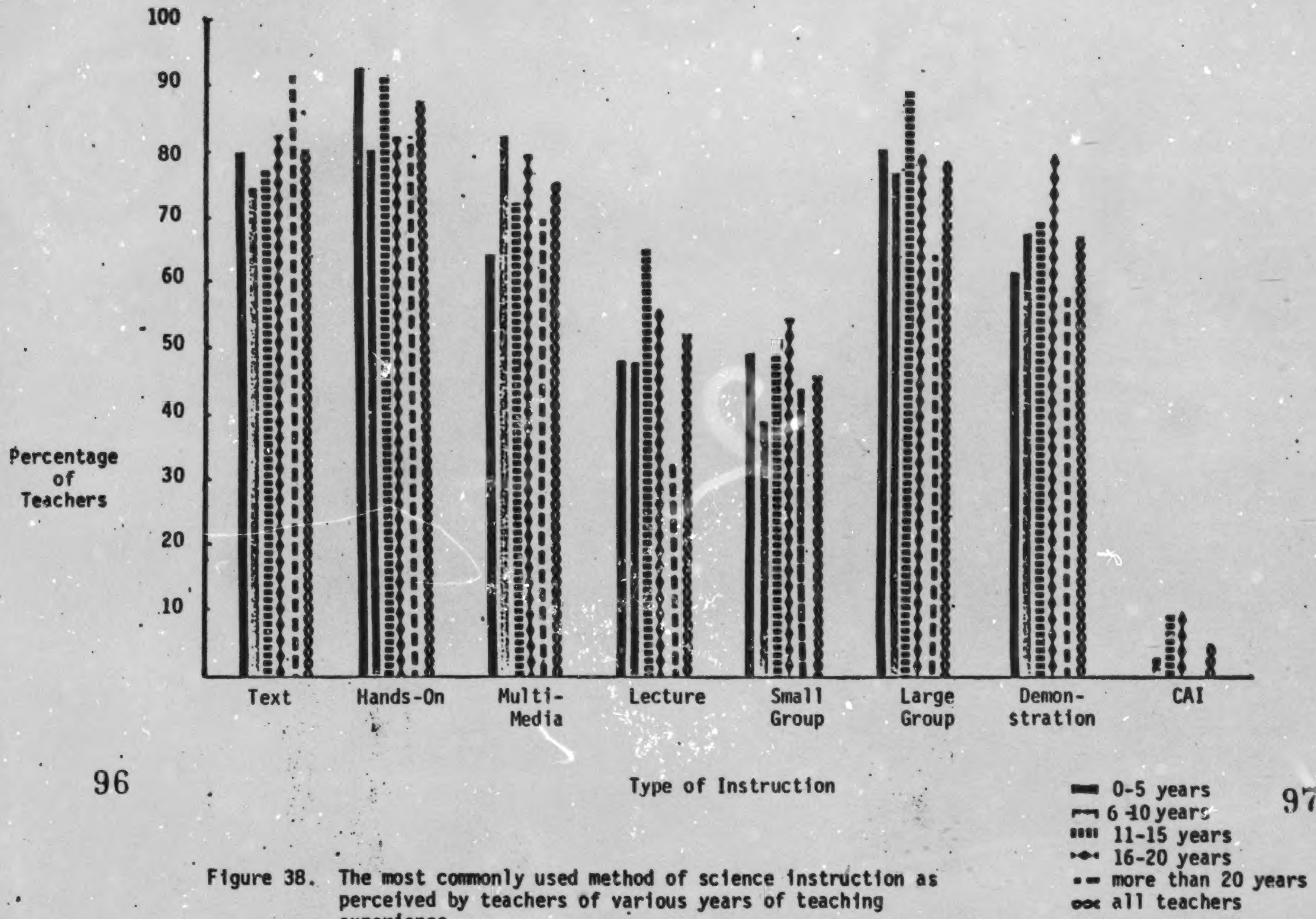


Figure 38. The most commonly used method of science instruction as perceived by teachers of various years of teaching experience.

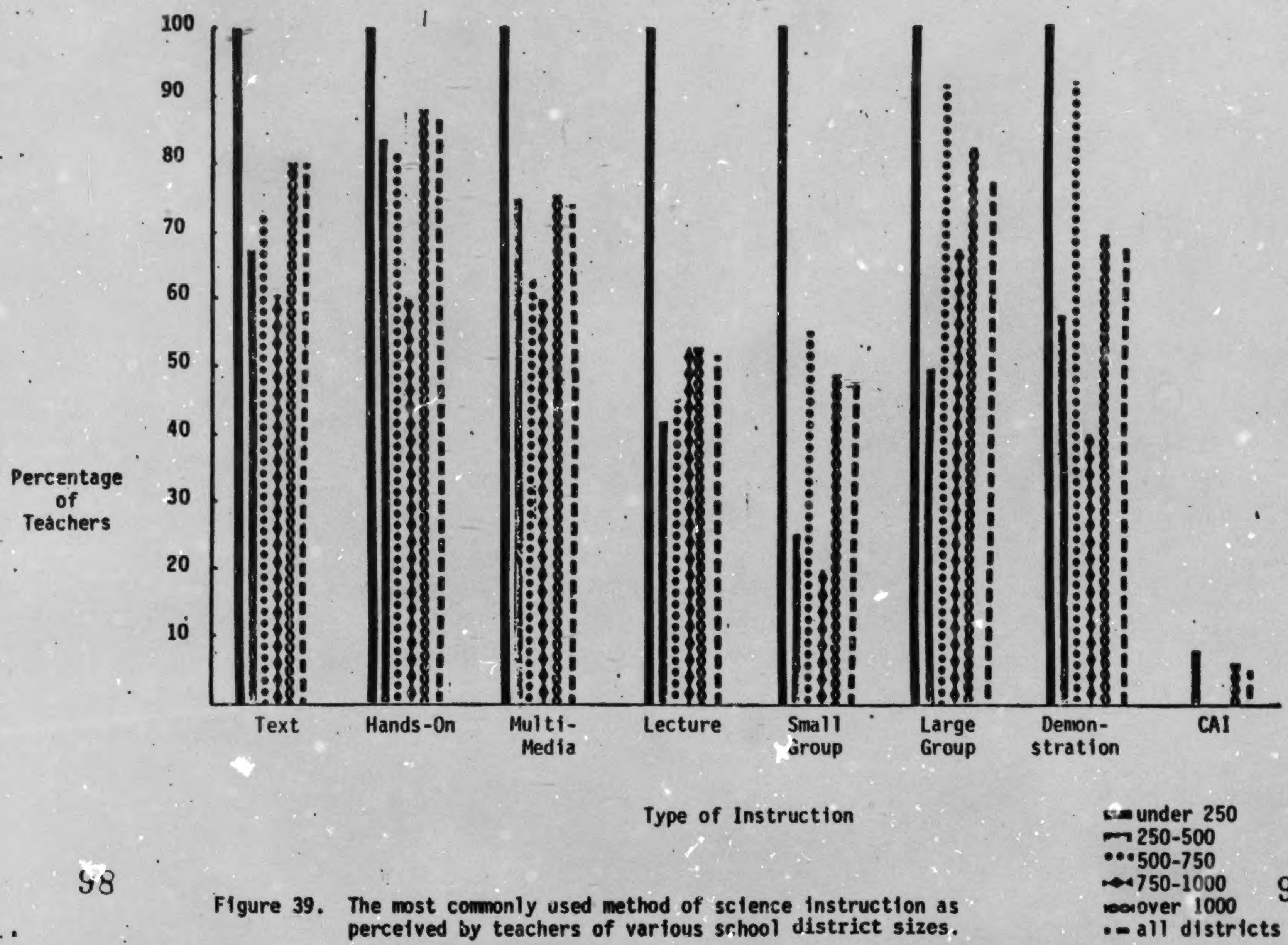


Figure 39. The most commonly used method of science instruction as perceived by teachers of various school district sizes.

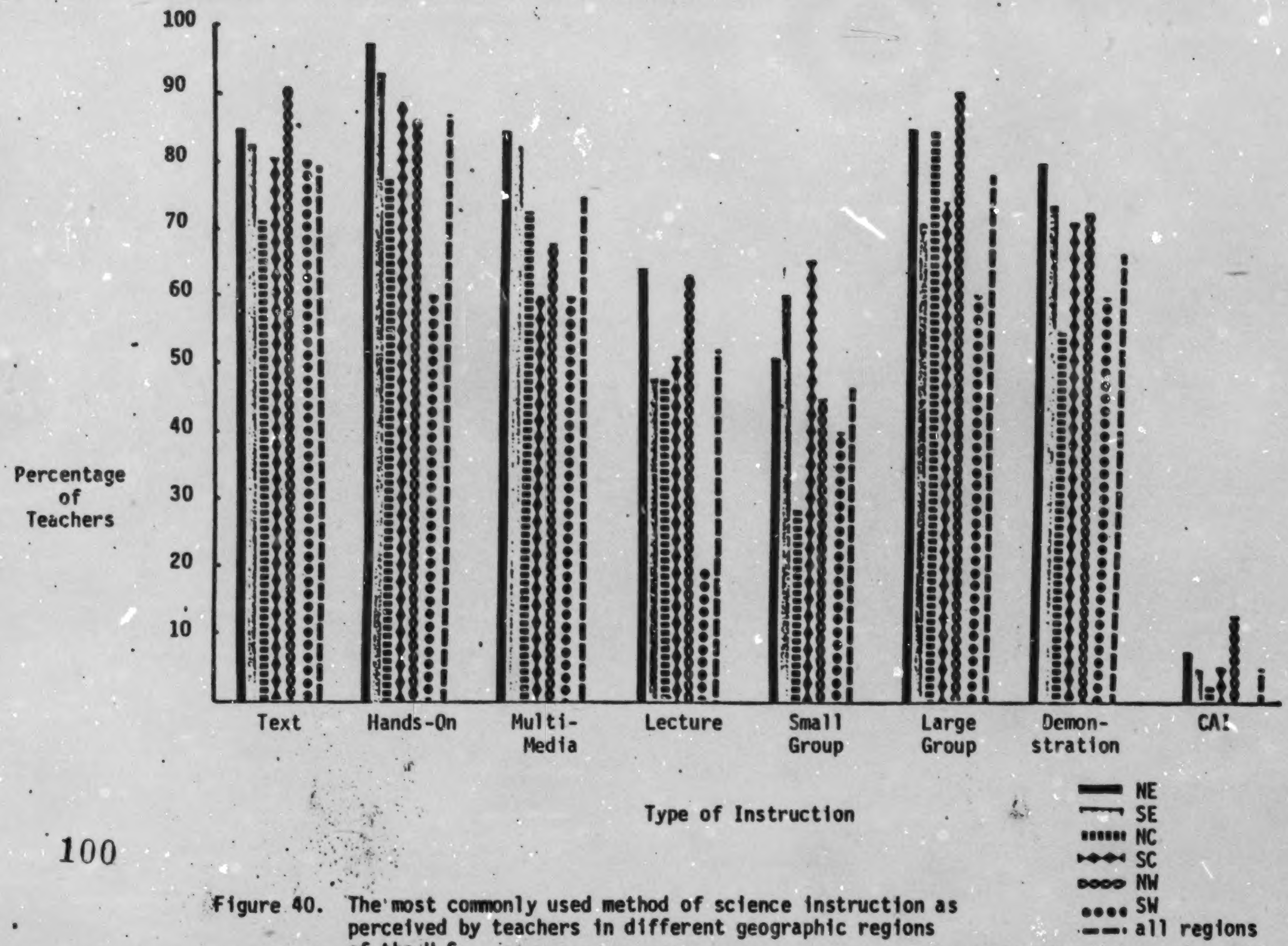


Figure 40. The most commonly used method of science instruction as perceived by teachers in different geographic regions of the U.S.

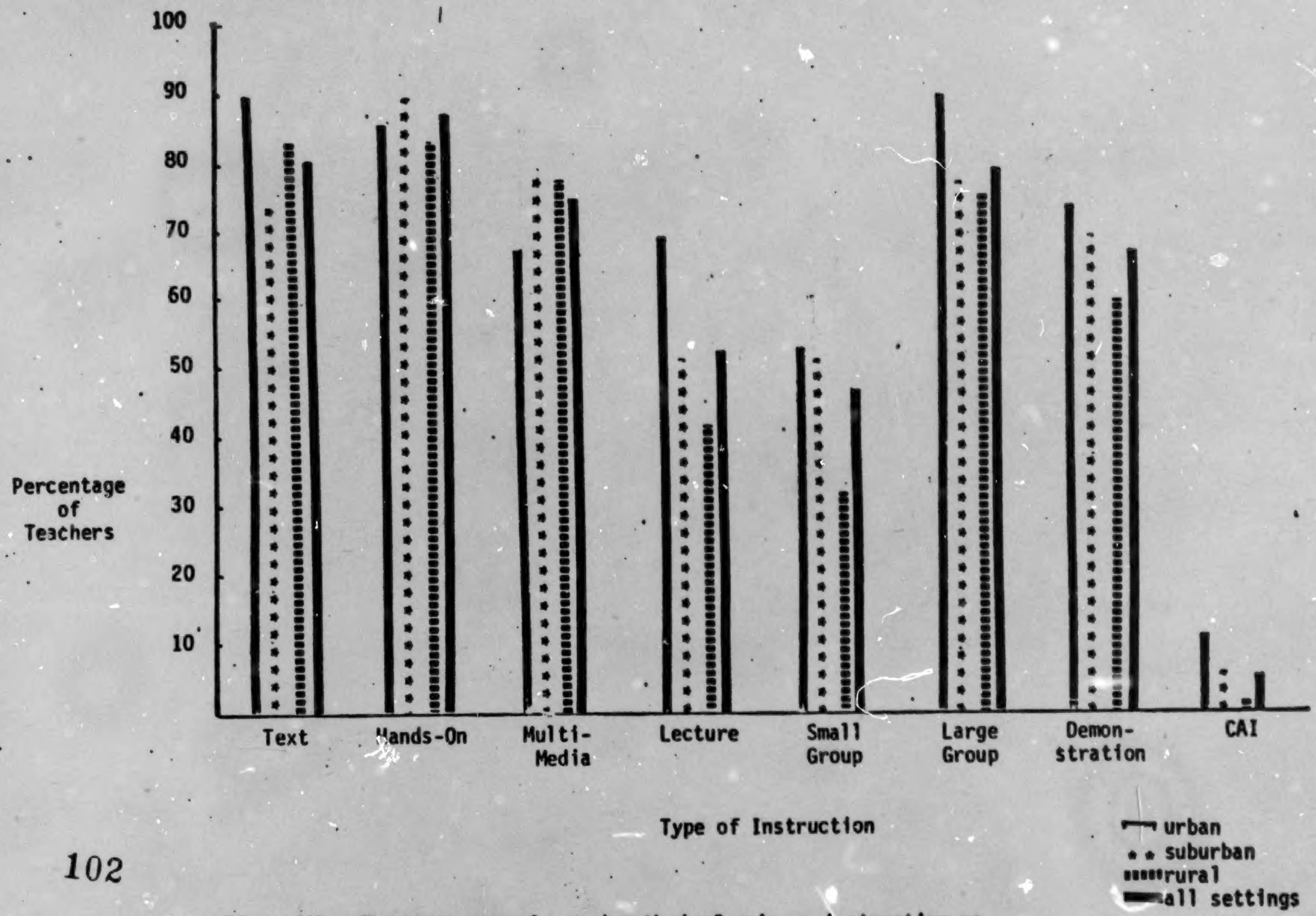


Figure 41. The most commonly used method of science instruction as perceived by teachers in different types of residential settings.

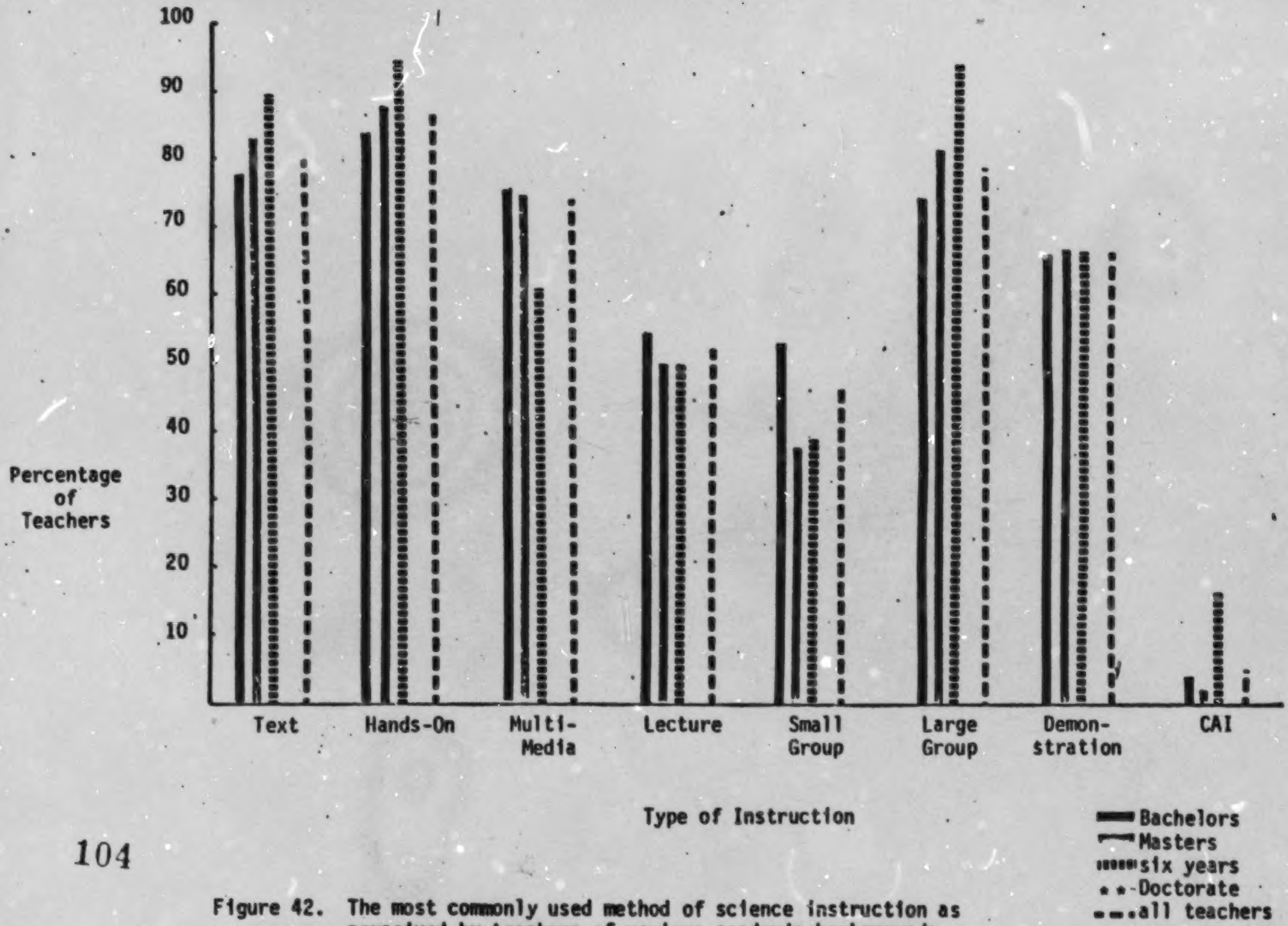


Figure 42. The most commonly used method of science instruction as perceived by teachers of various academic backgrounds.

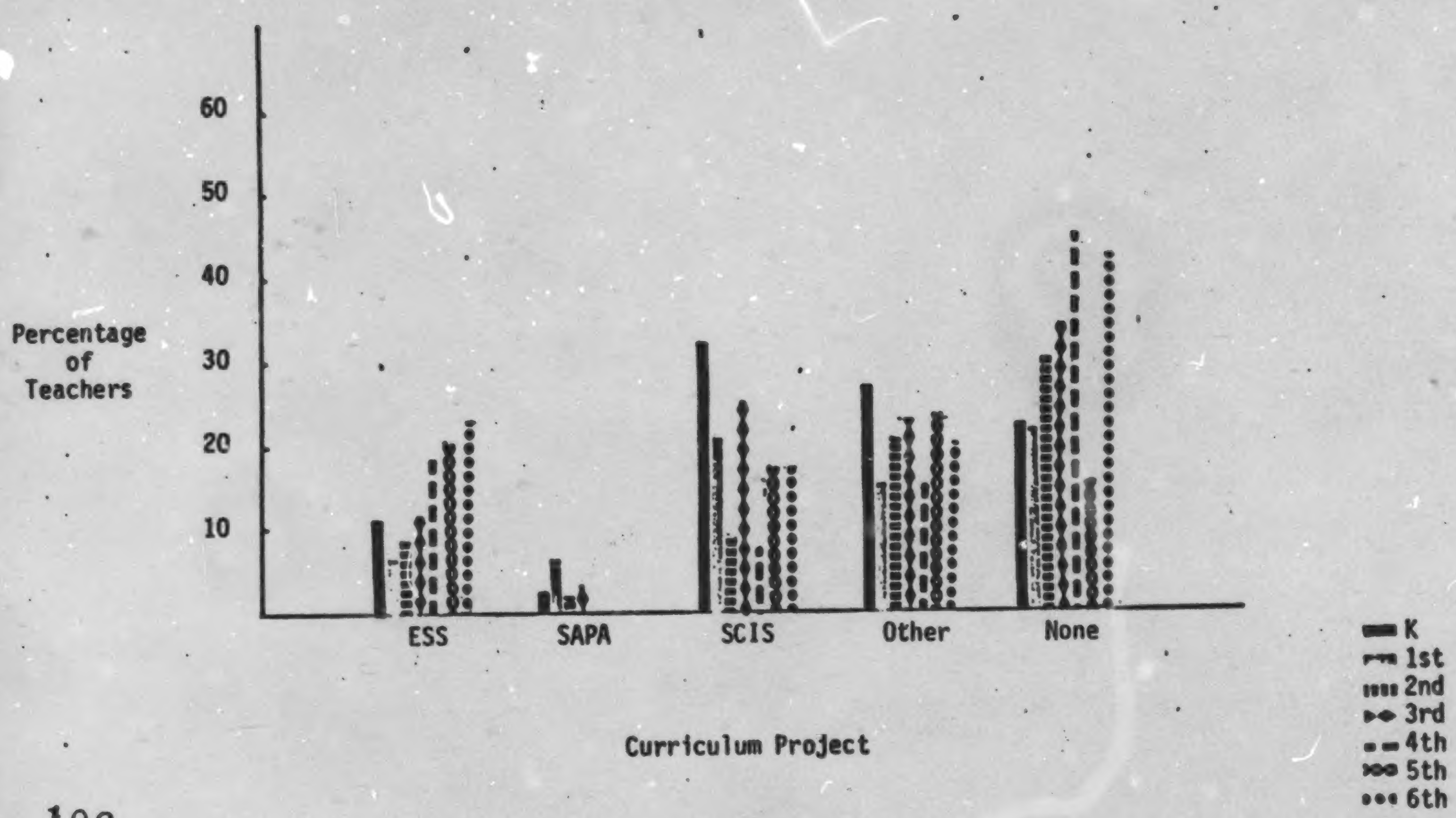


Figure 43. The use of process-based national curriculum projects according to grade.

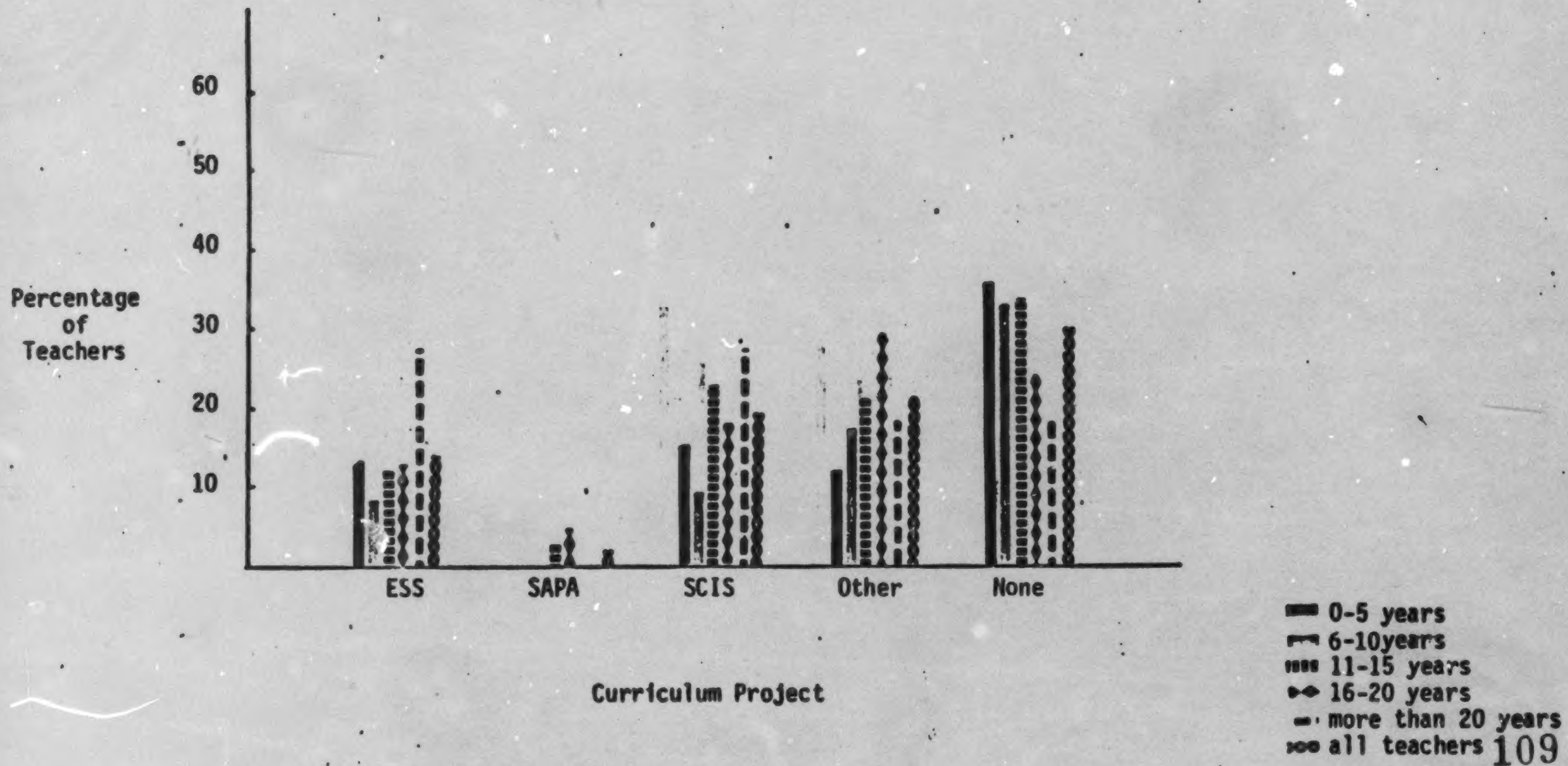


Figure 44. The use of process-based national curriculum projects as perceived by teachers of various years of teaching experience.

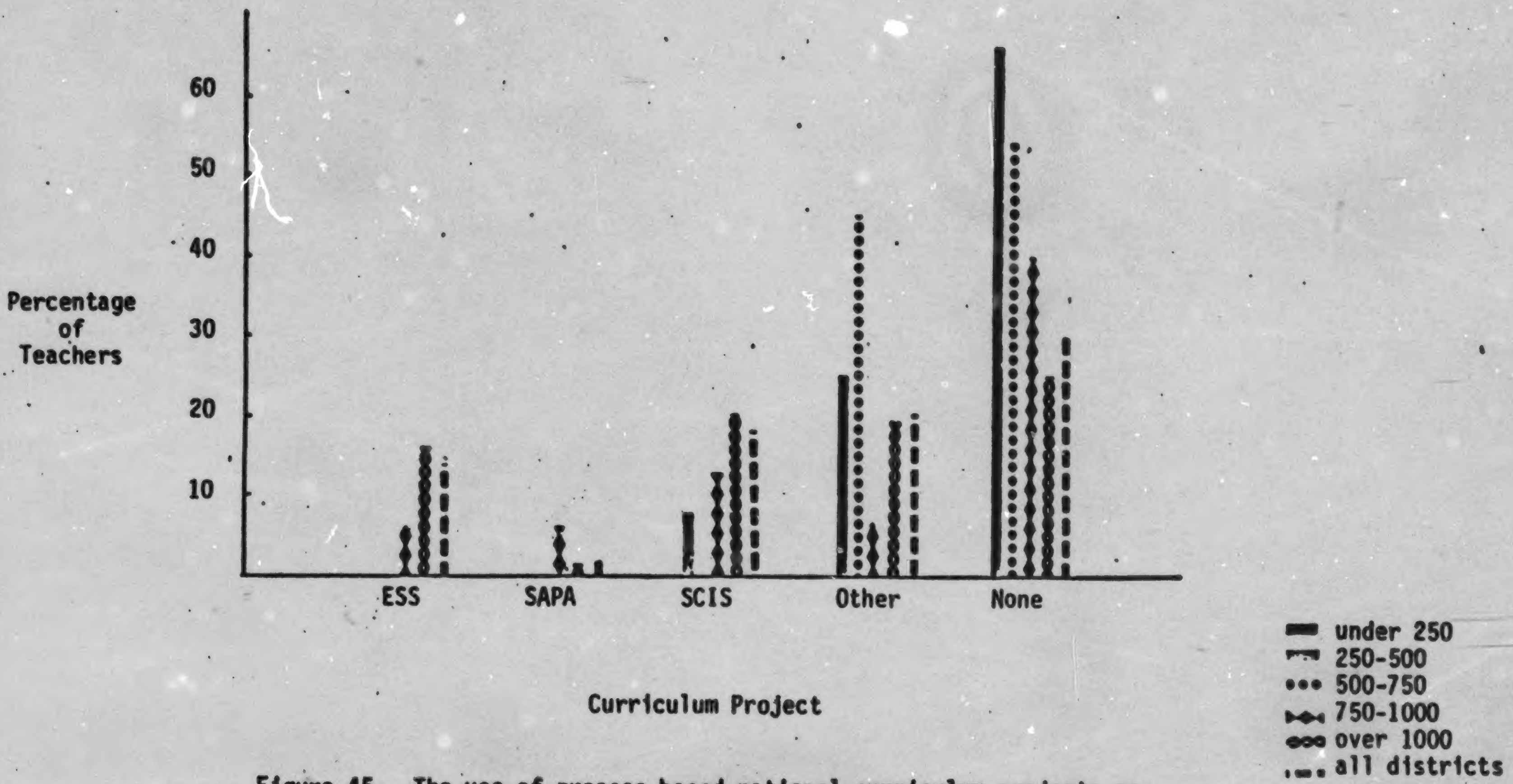


Figure 45. The use of process-based national curriculum projects as perceived by teachers of various school district sizes.

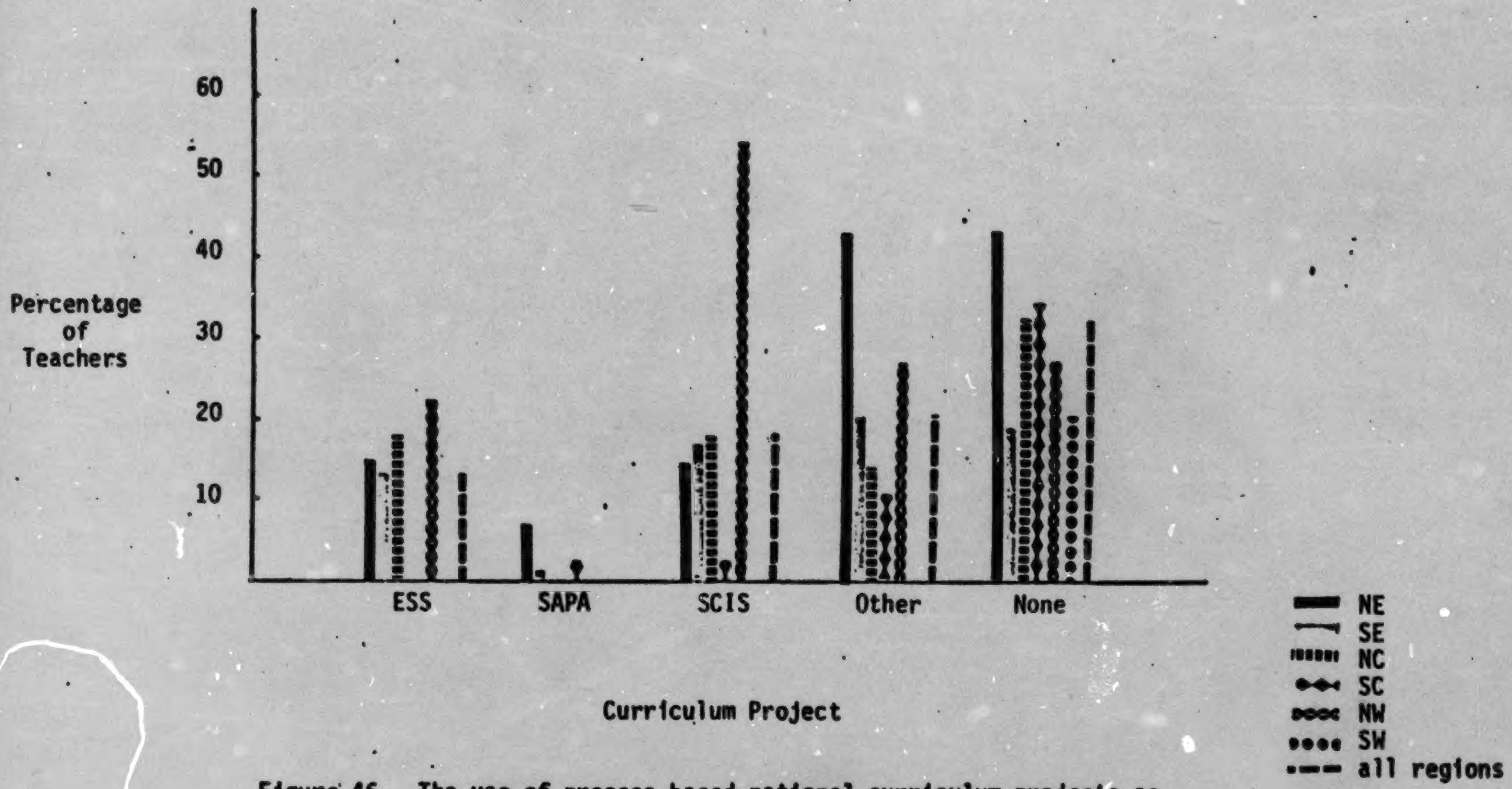


Figure 46. The use of process-based national curriculum projects as perceived by teachers in different geographic regions of the U.S.

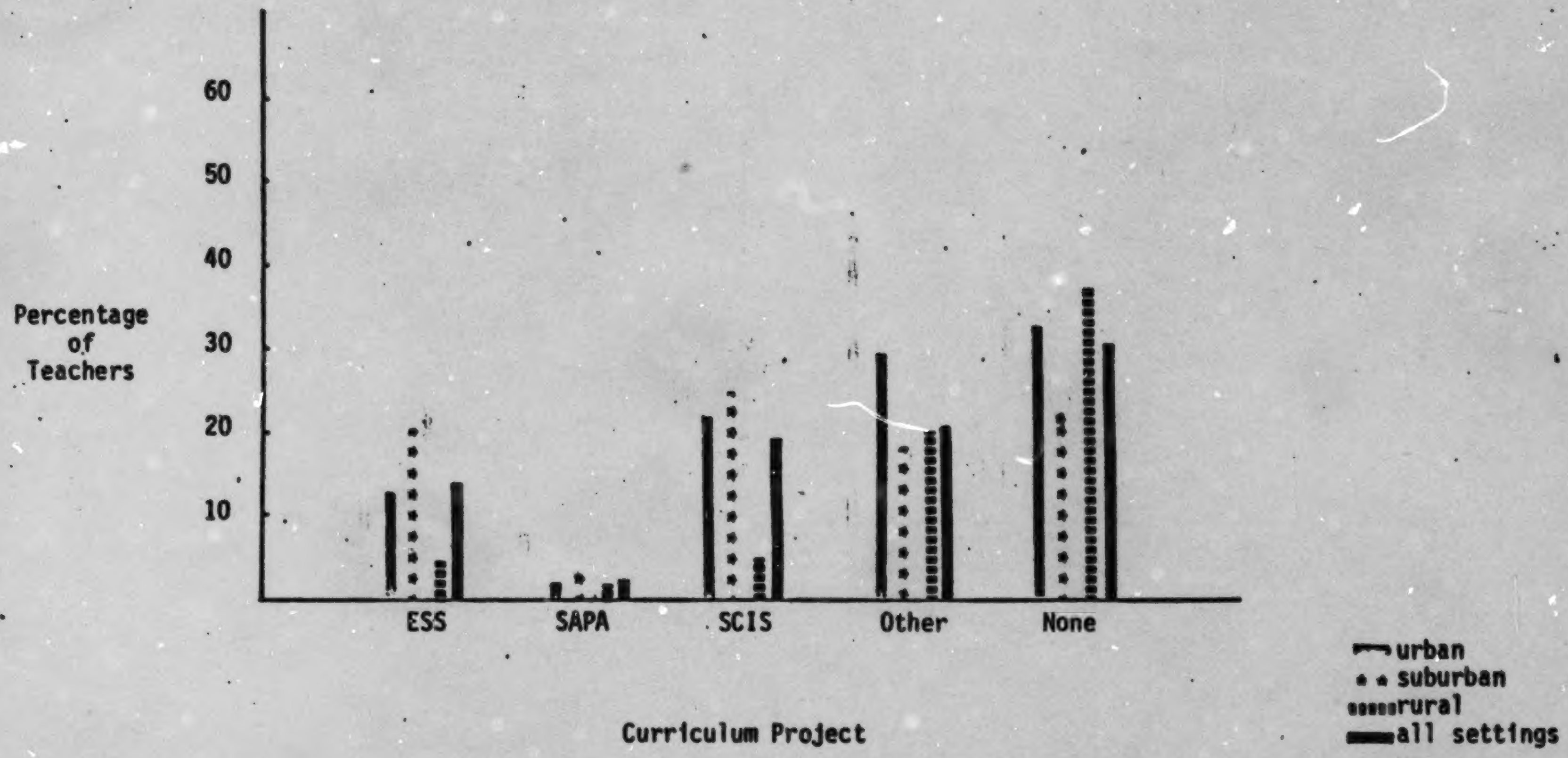


Figure 47. The use of process-based national curriculum projects as perceived by teachers in different types of residential settings.

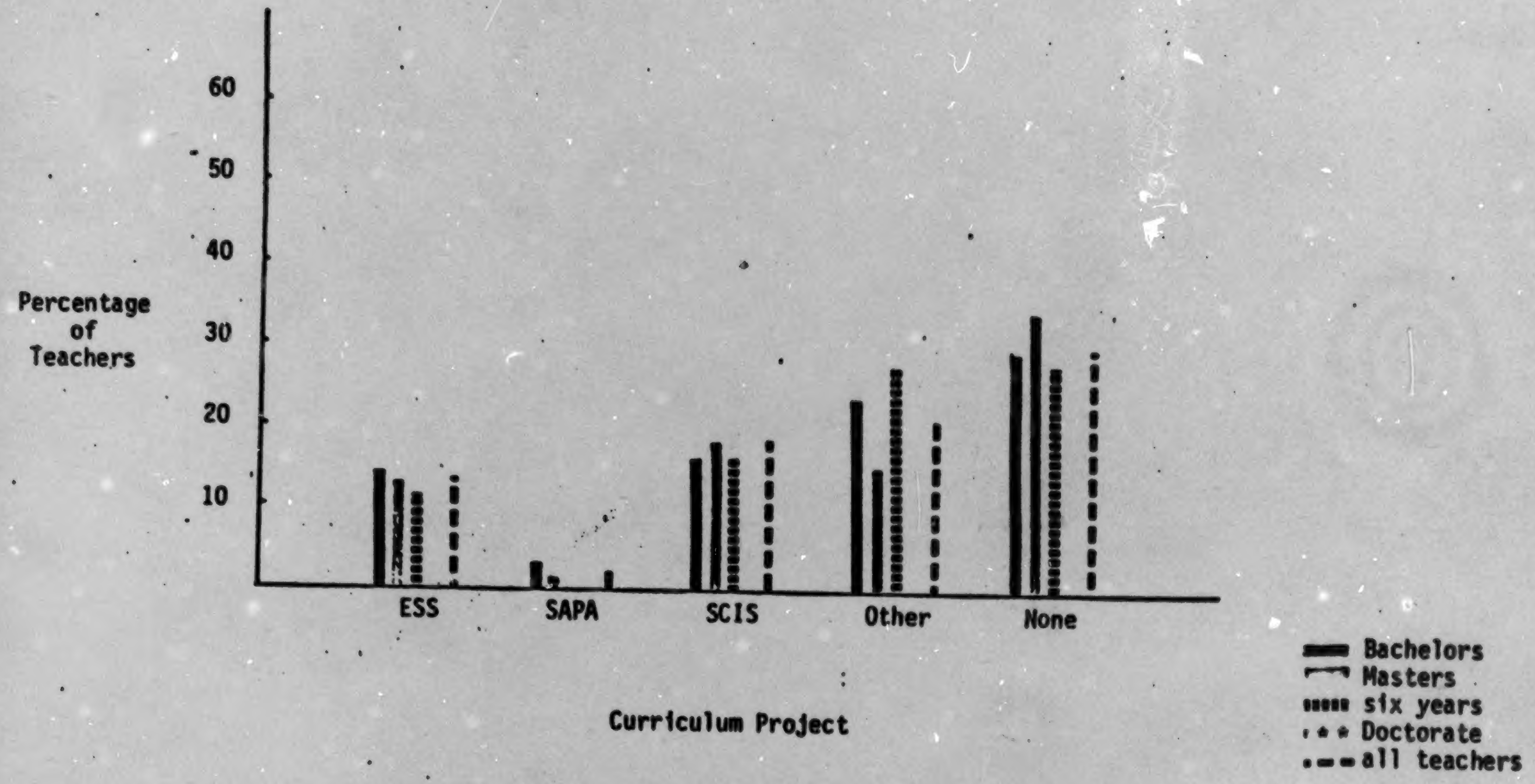


Figure 48. The use of process-based national curriculum projects as perceived by teachers of various academic backgrounds.

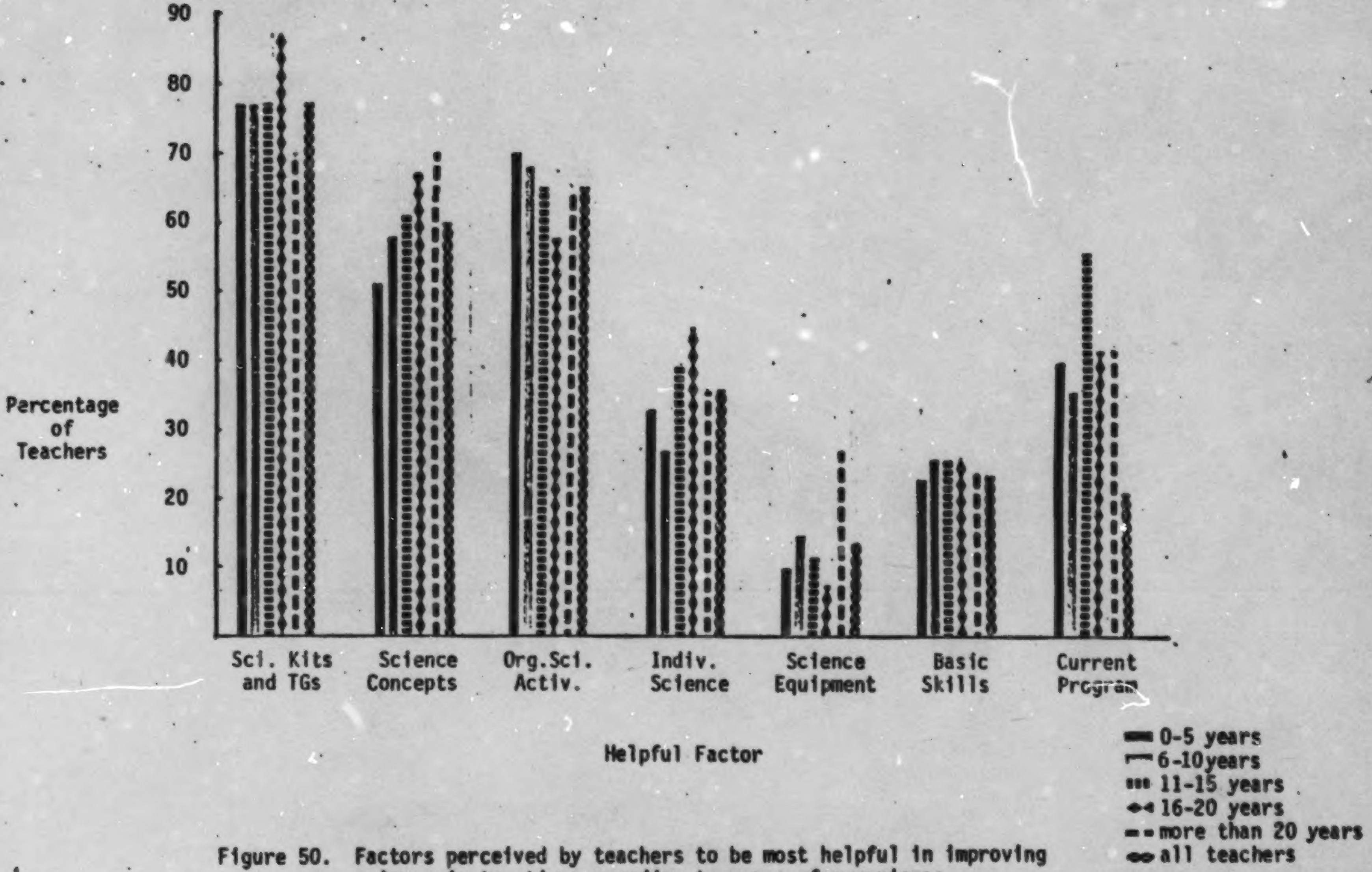


Figure 50. Factors perceived by teachers to be most helpful in improving science instruction according to years of experience.

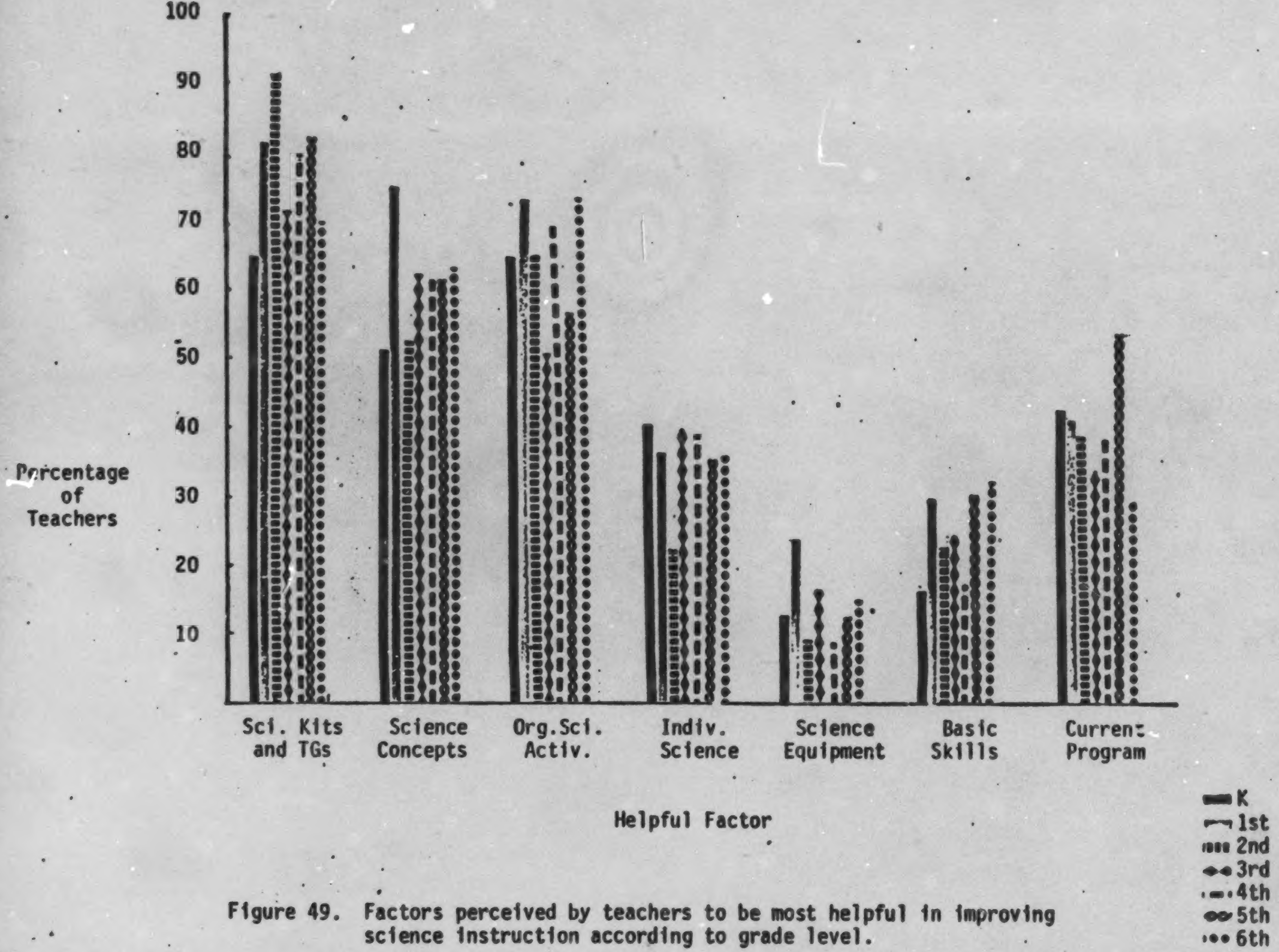


Figure 49. Factors perceived by teachers to be most helpful in improving science instruction according to grade level.

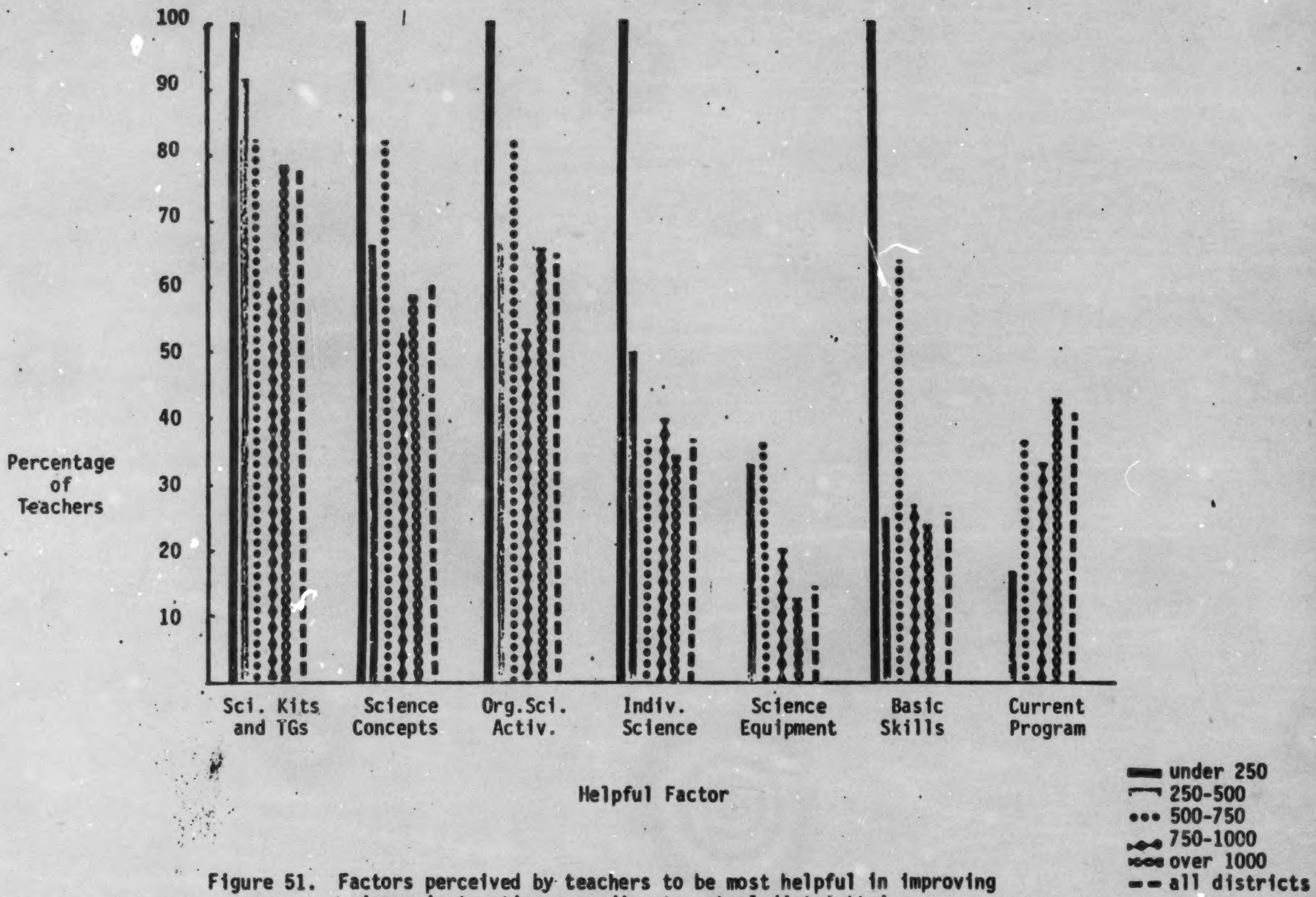


Figure 51. Factors perceived by teachers to be most helpful in improving science instruction according to school district size.

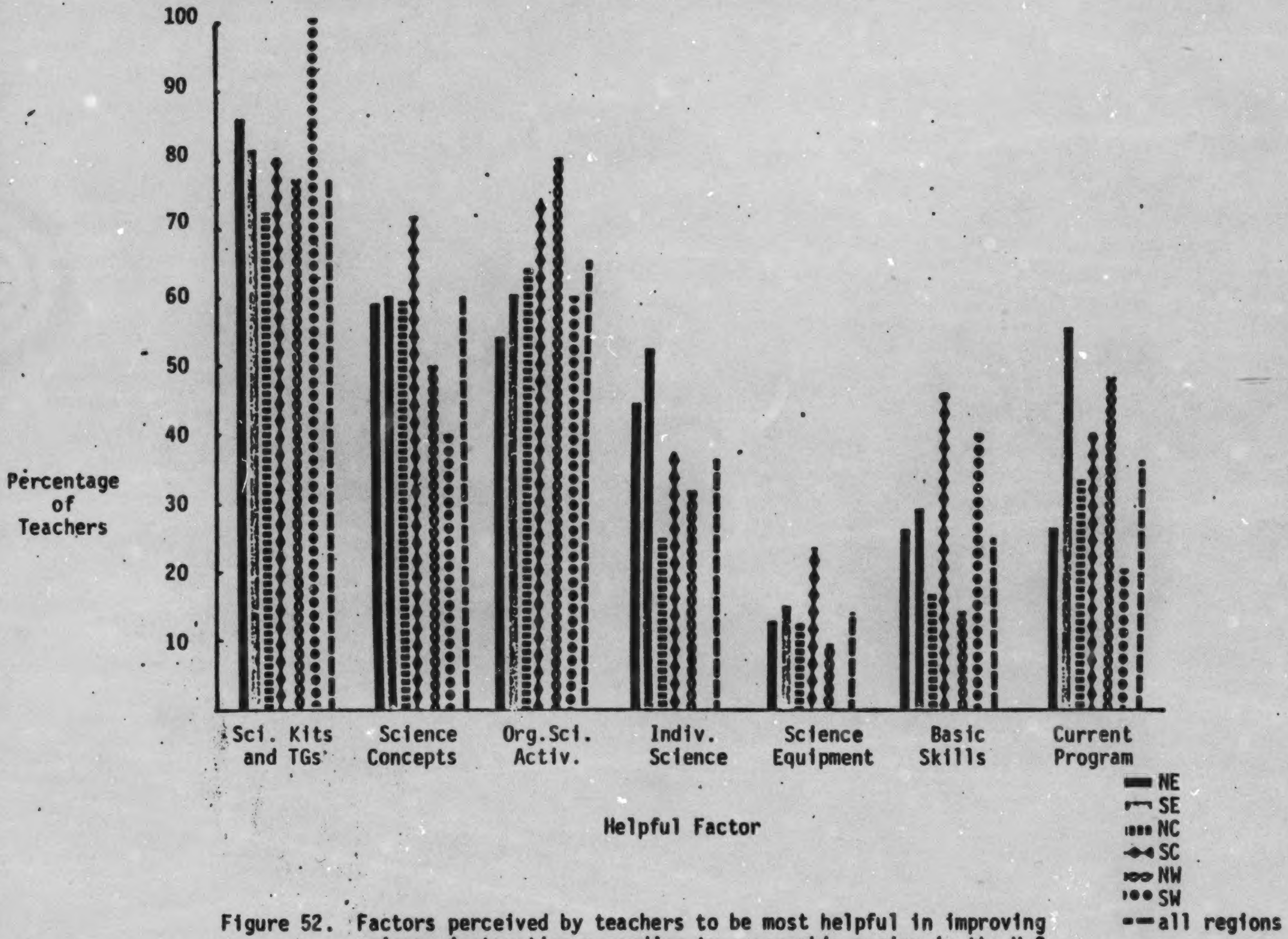


Figure 52. Factors perceived by teachers to be most helpful in improving science instruction according to geographic region in the U.S.

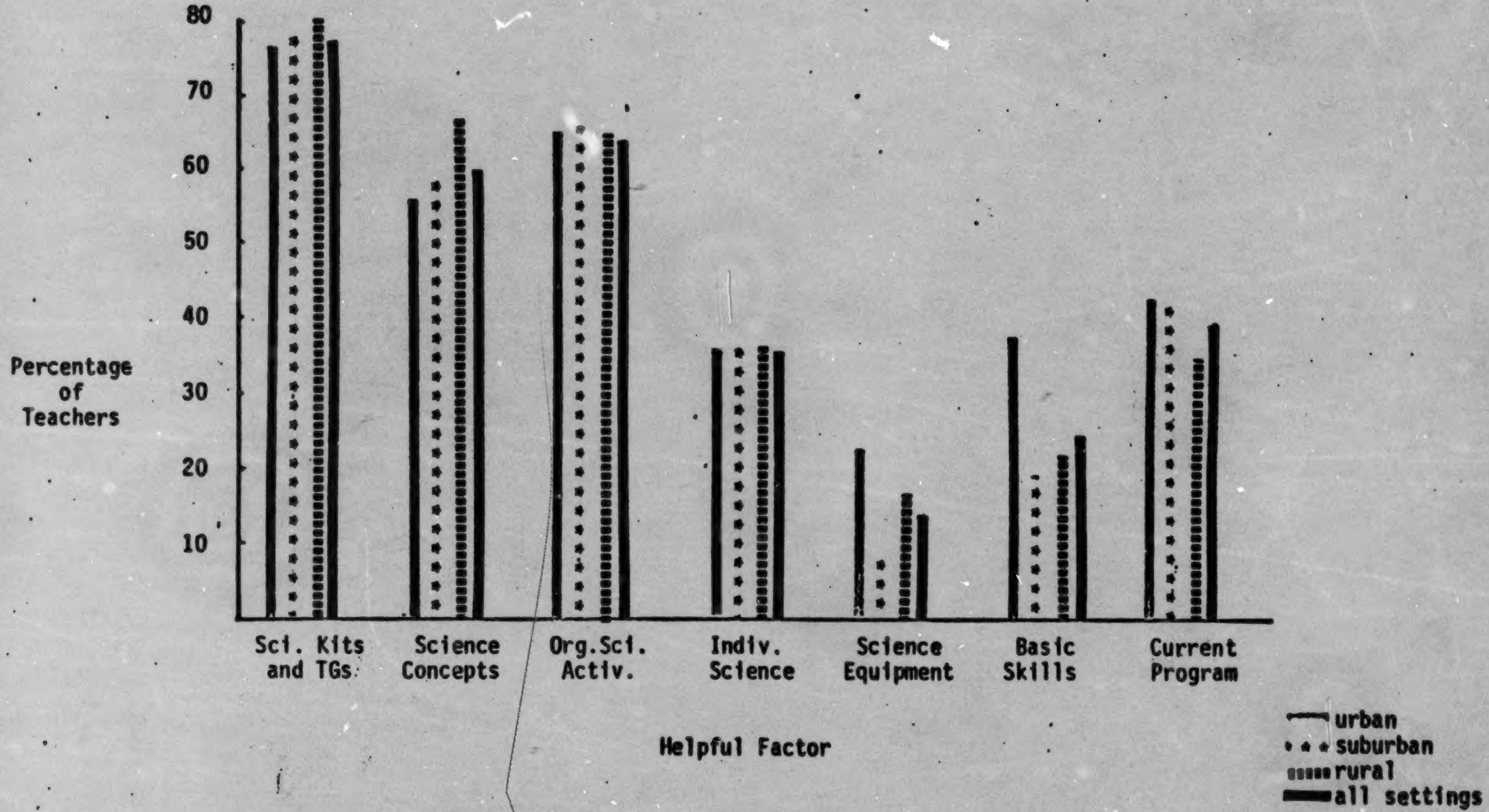


Figure 53. Factors perceived by teachers to be most helpful in improving science instruction according to residential setting.

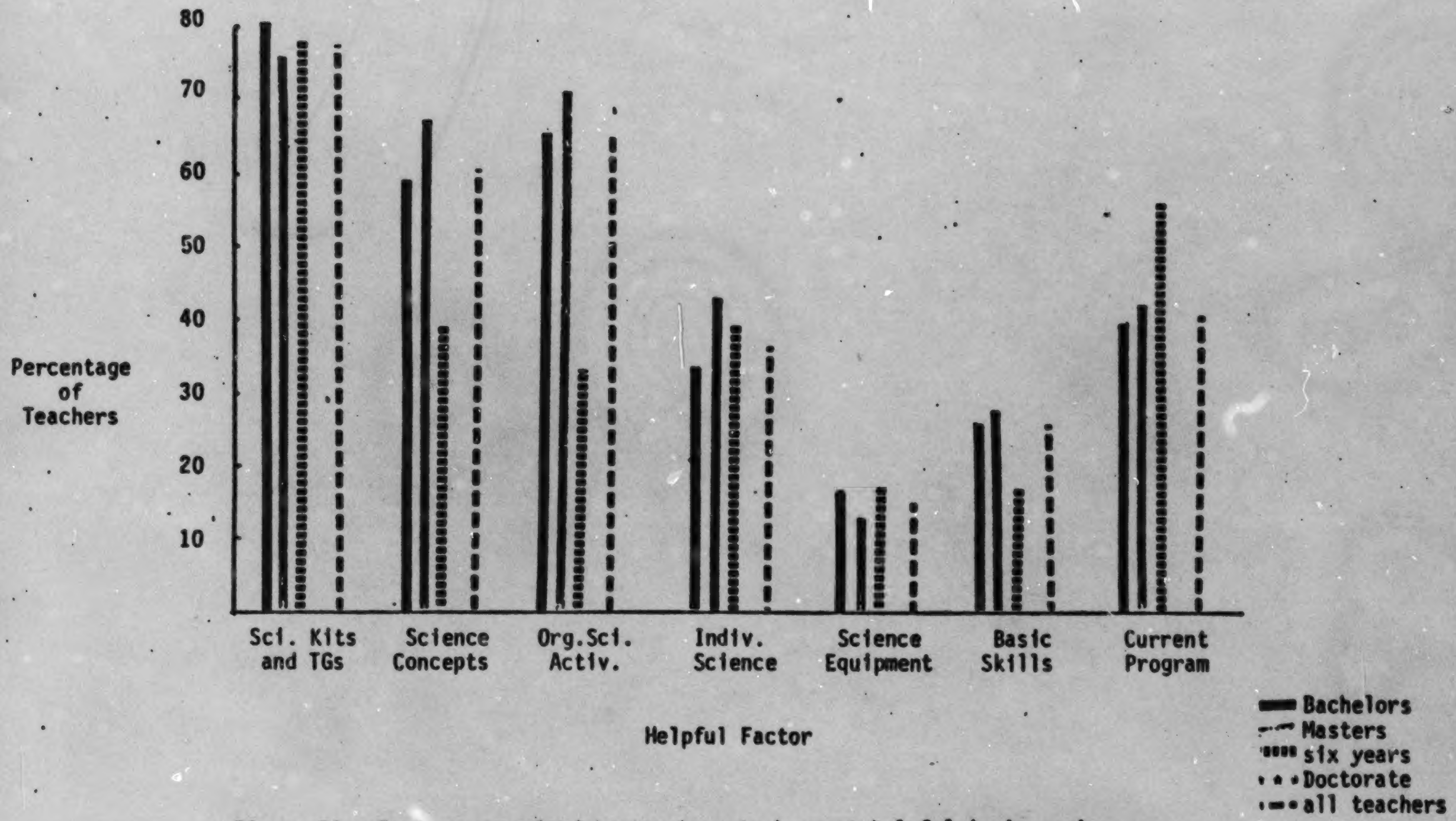


Figure 54. Factors perceived by teachers to be most helpful in improving science instruction according to teachers academic background.

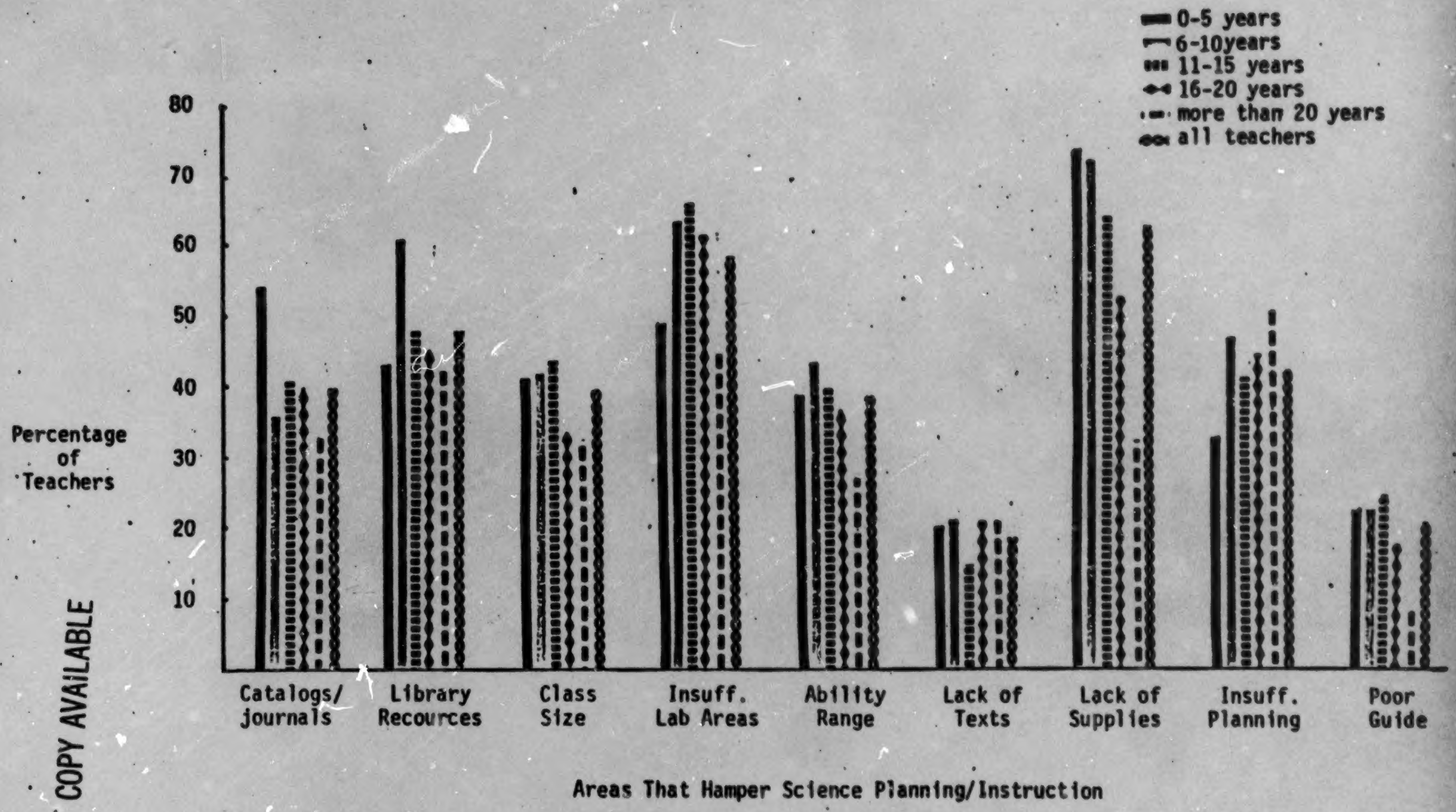


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Figure 56. Areas perceived by teachers that hamper science planning and instruction according to years of experience.

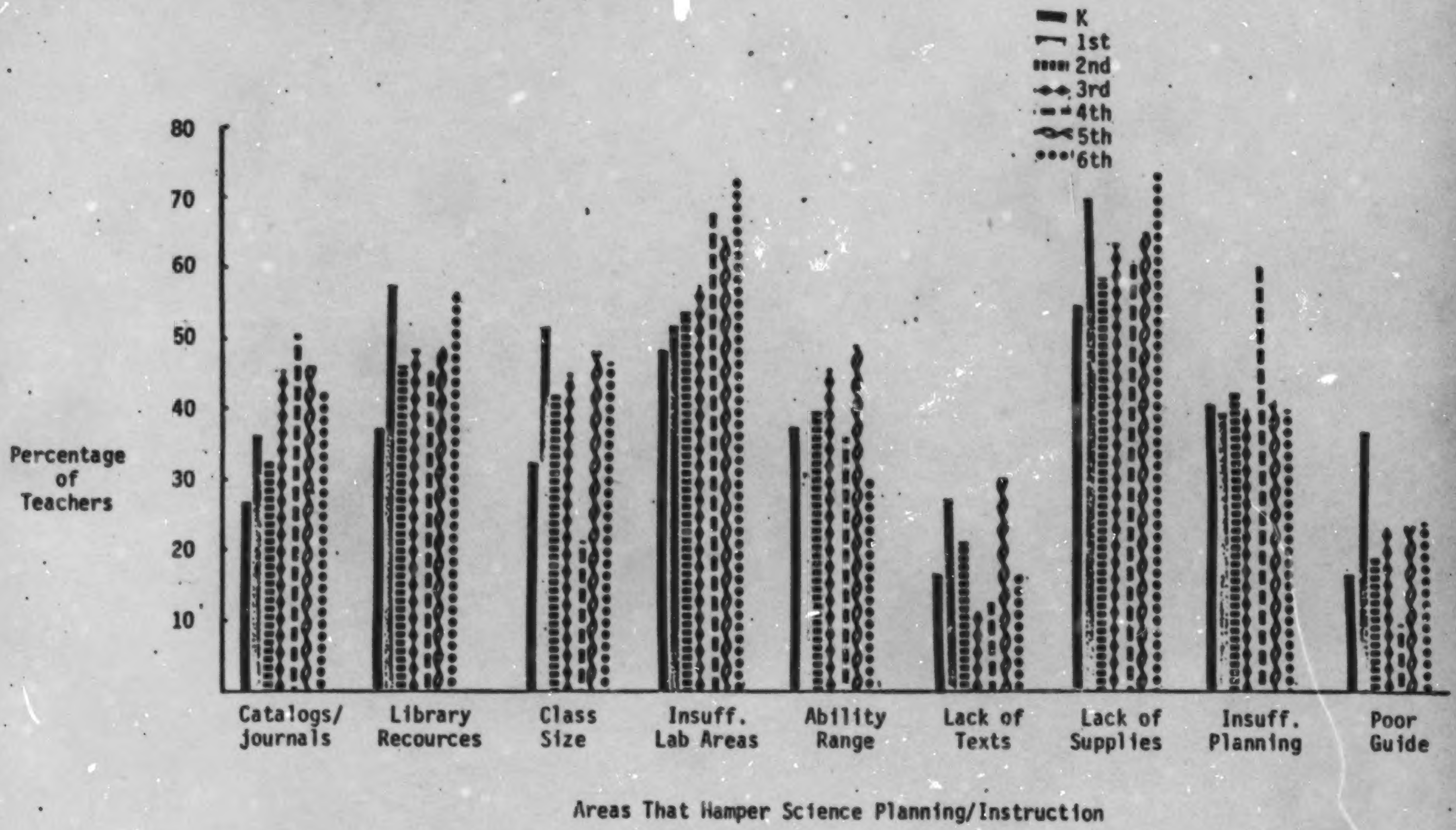

Figure 55. Areas perceived by teachers that hamper science planning and instruction according to grade.

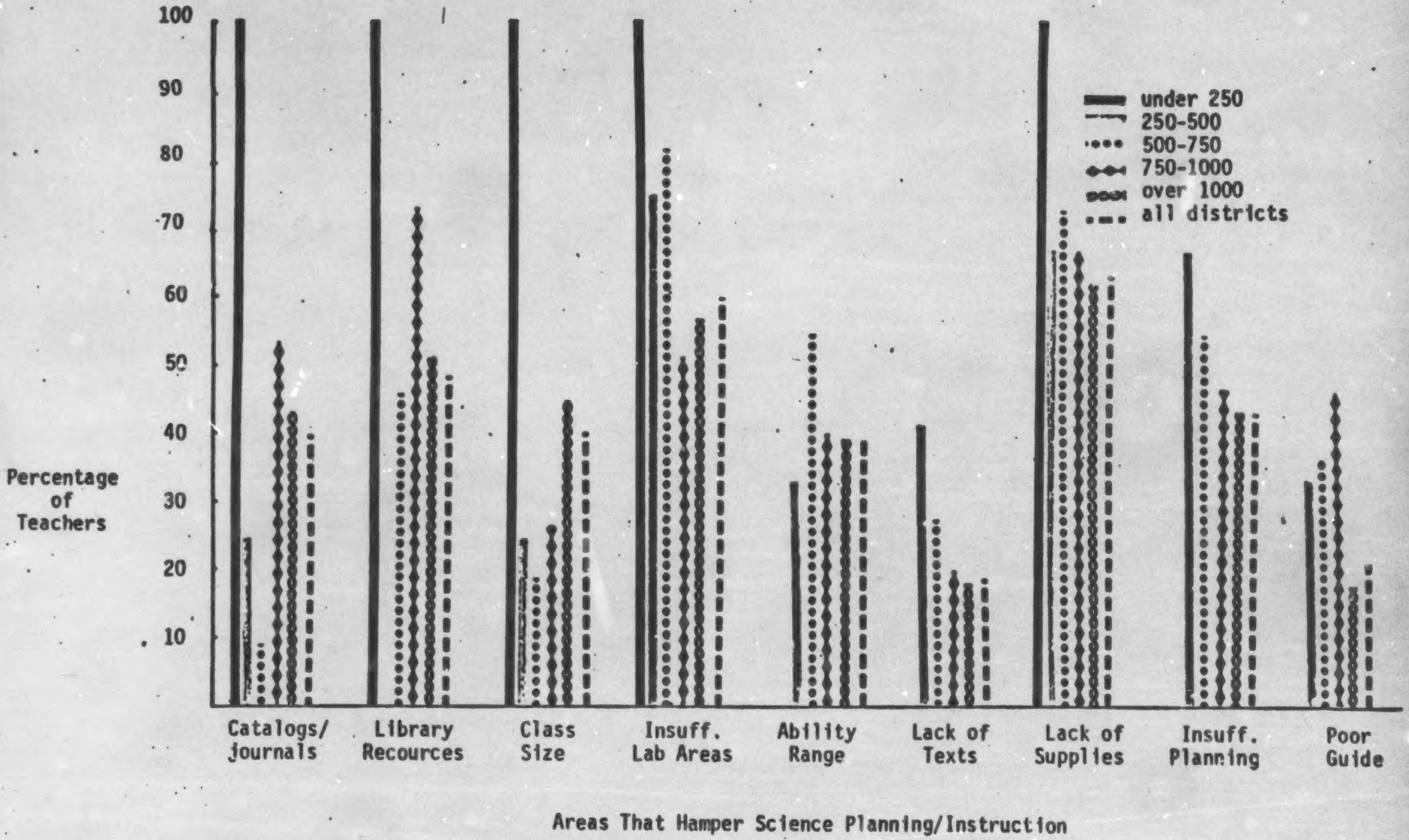

Figure 57. Areas perceived by teachers that hamper science planning and instruction according to school district size.

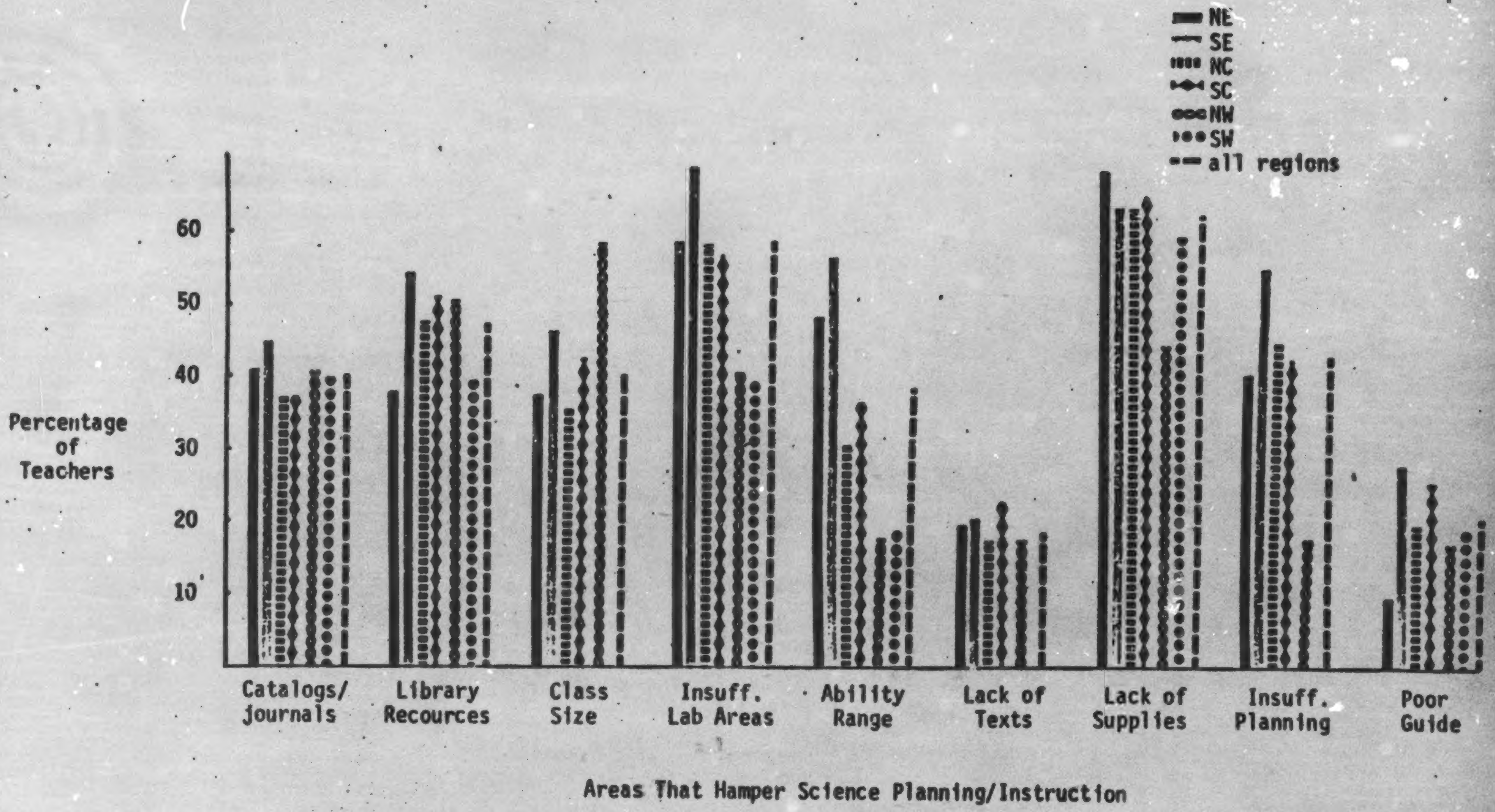

Figure 58. Areas perceived by teachers that hamper science planning and instruction according to geographic region in the U.S.

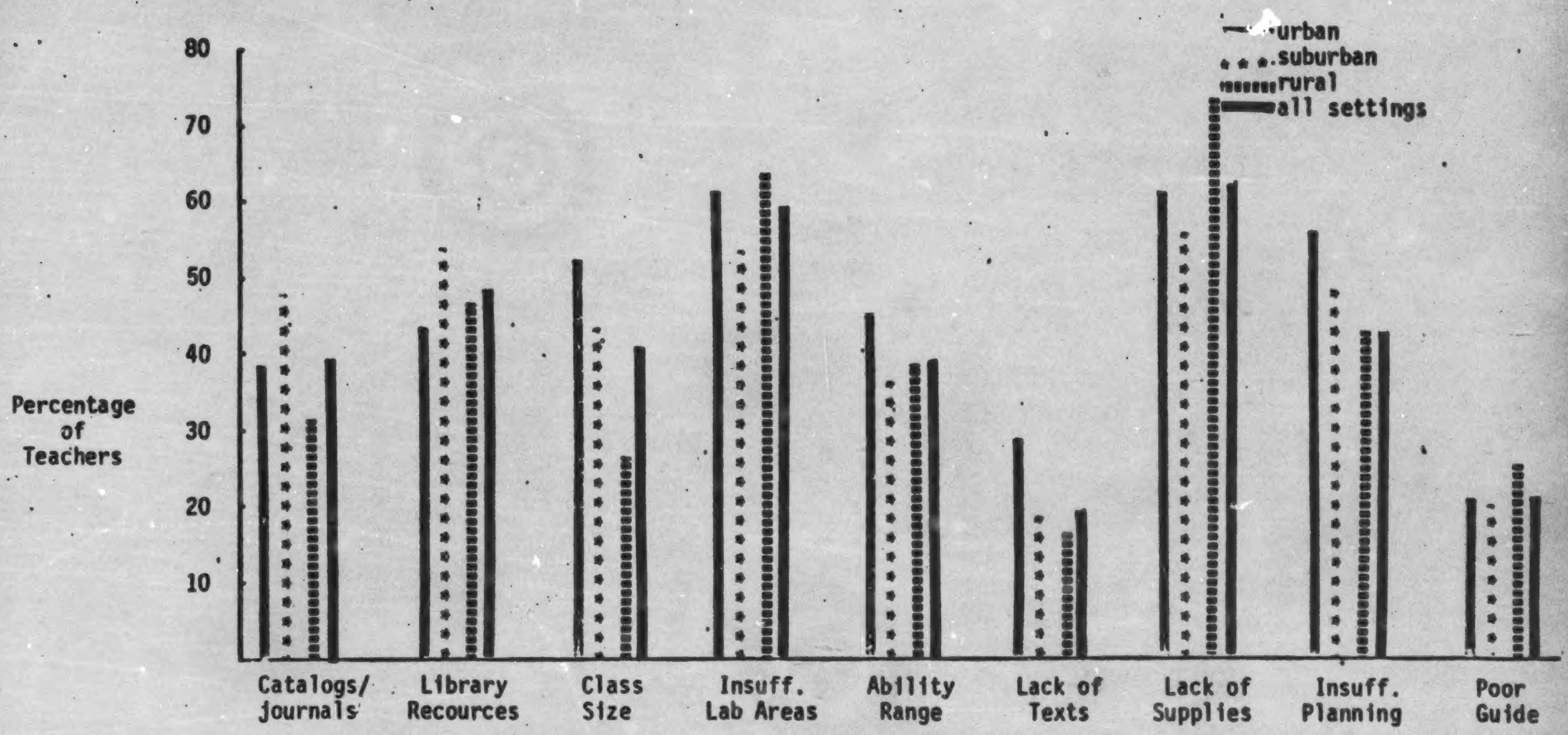

Figure 59. Areas perceived by teachers that hamper science planning and instruction according to residential setting.

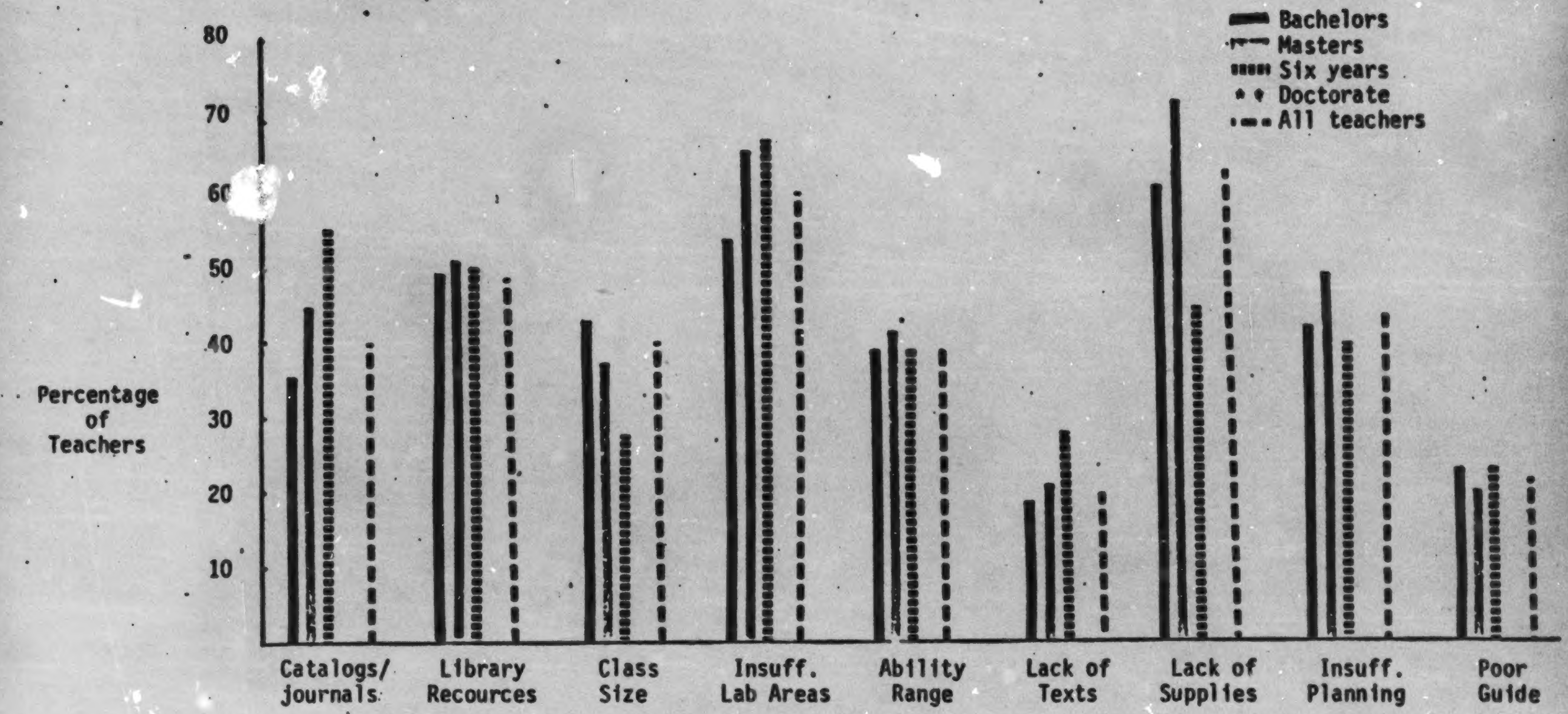

Figure 60. Areas perceived by teachers that hamper science planning and instruction according to teachers academic background.

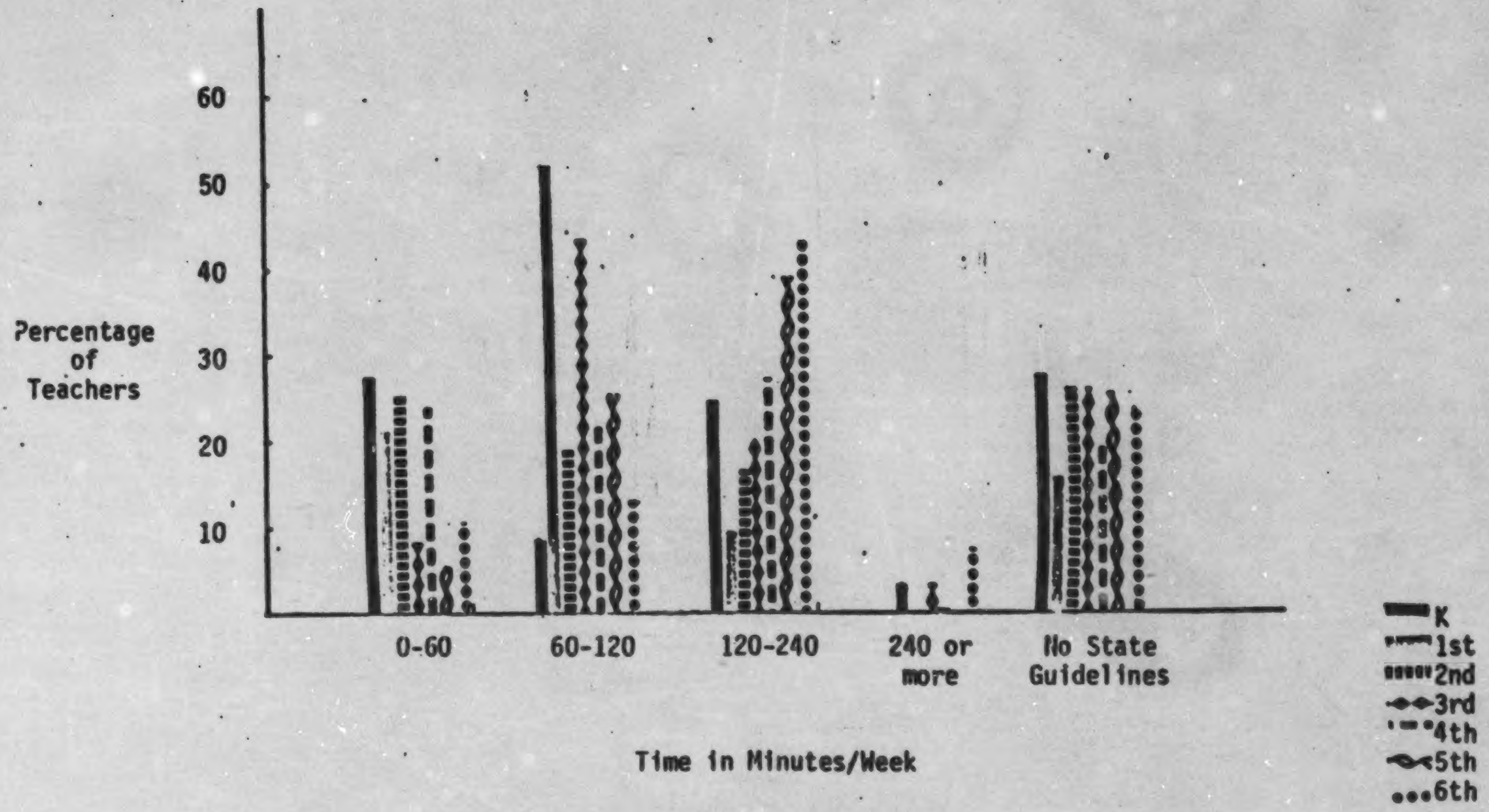

Figure 61. Time of instruction required by state guidelines as perceived by teachers according to grade.

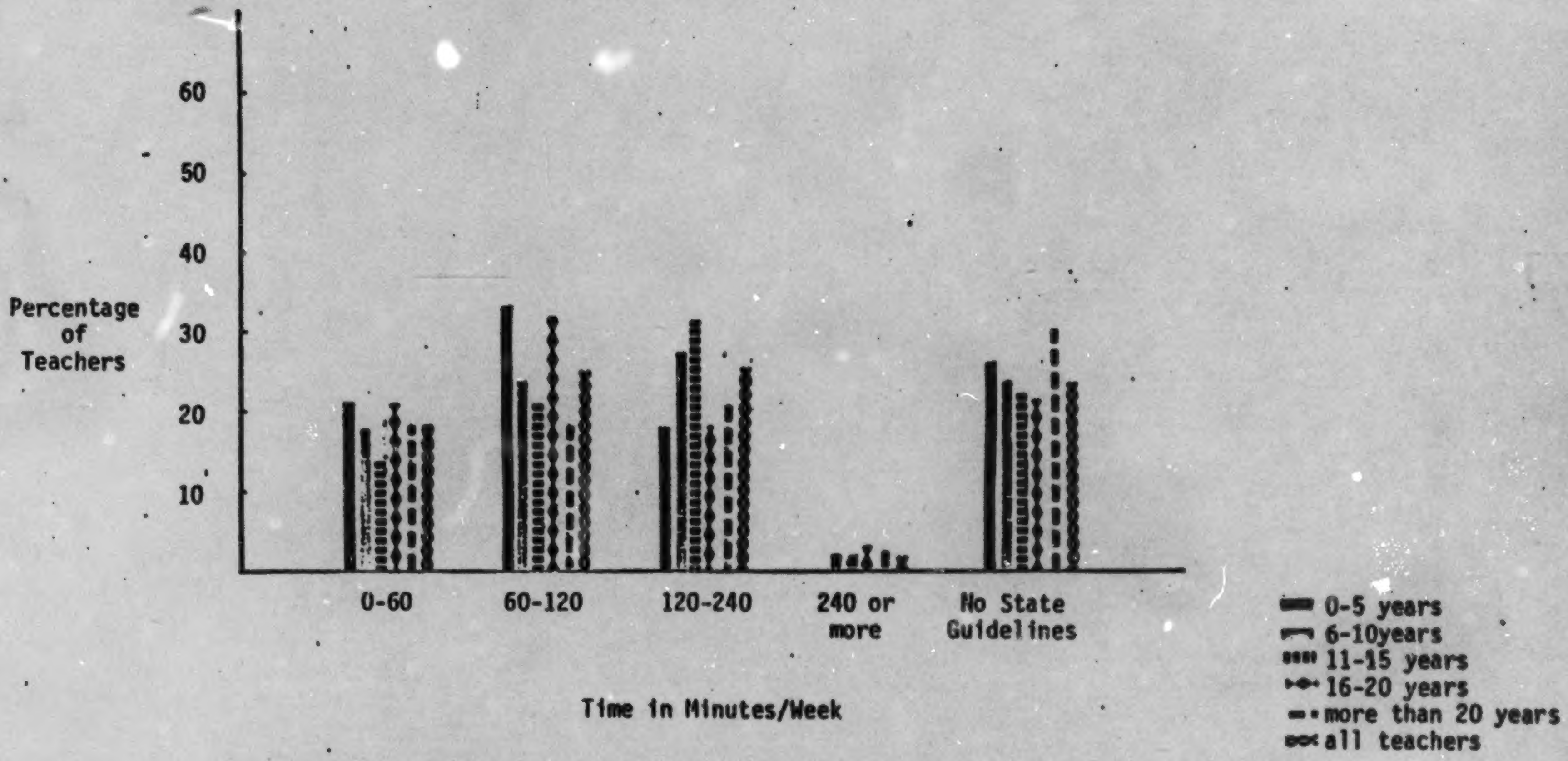

Figure 62. Time of instruction required by state guidelines as perceived by teachers according to years of experience.

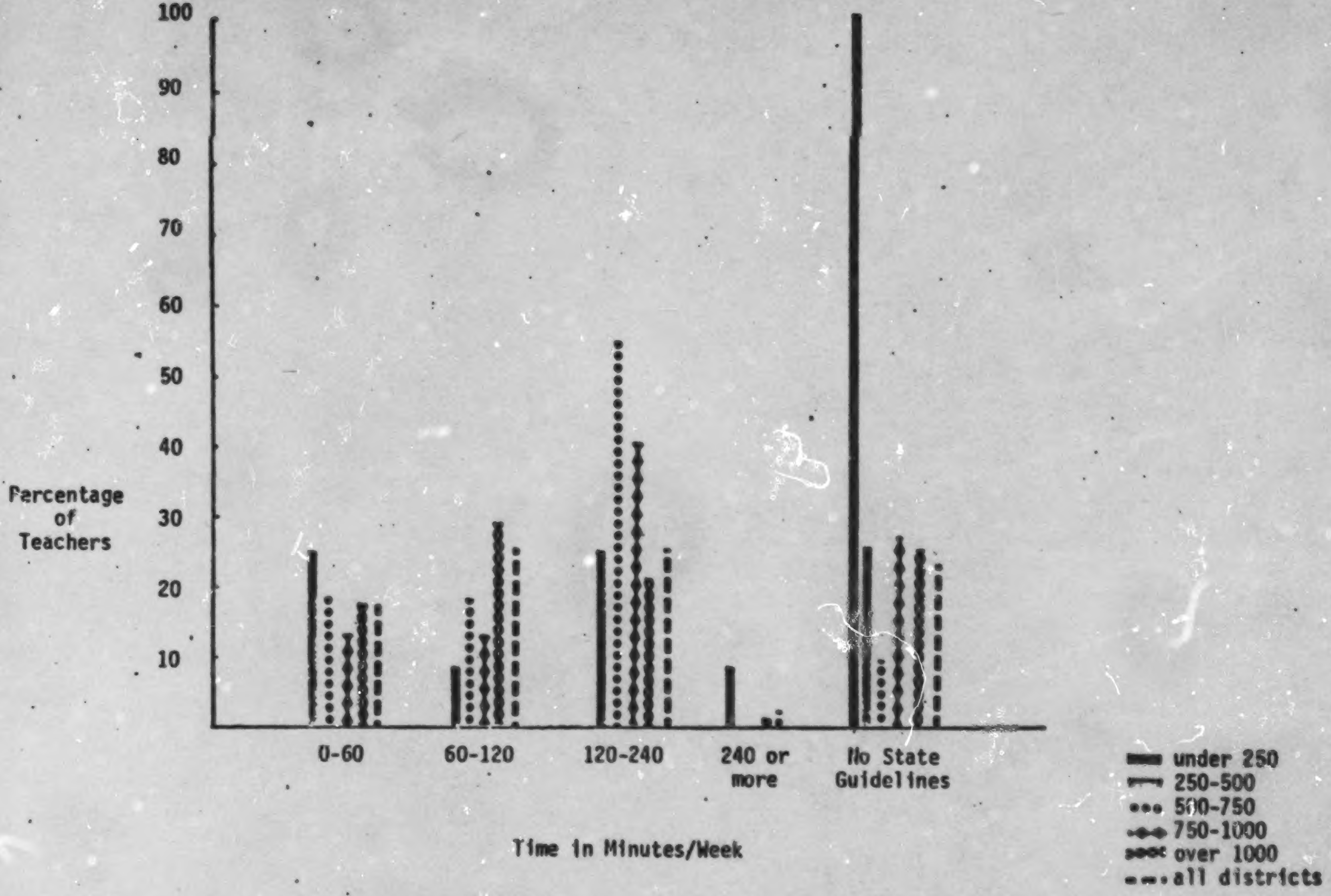

Figure 63. Time of instruction required by state guidelines as perceived by teachers according to school district size.

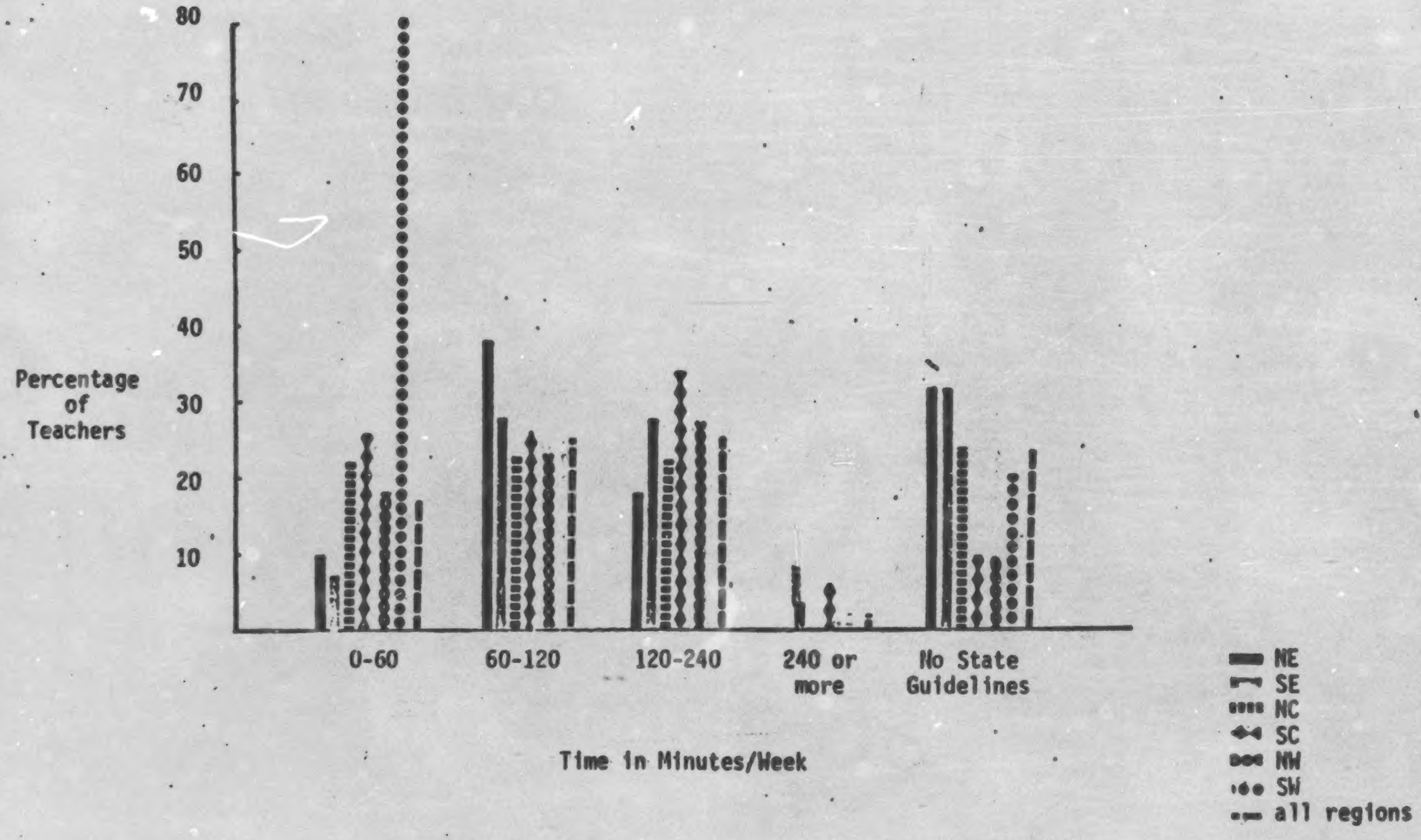

Figure 64. Time of instruction required by state guidelines as perceived by teachers according to geographic region in the U.S.

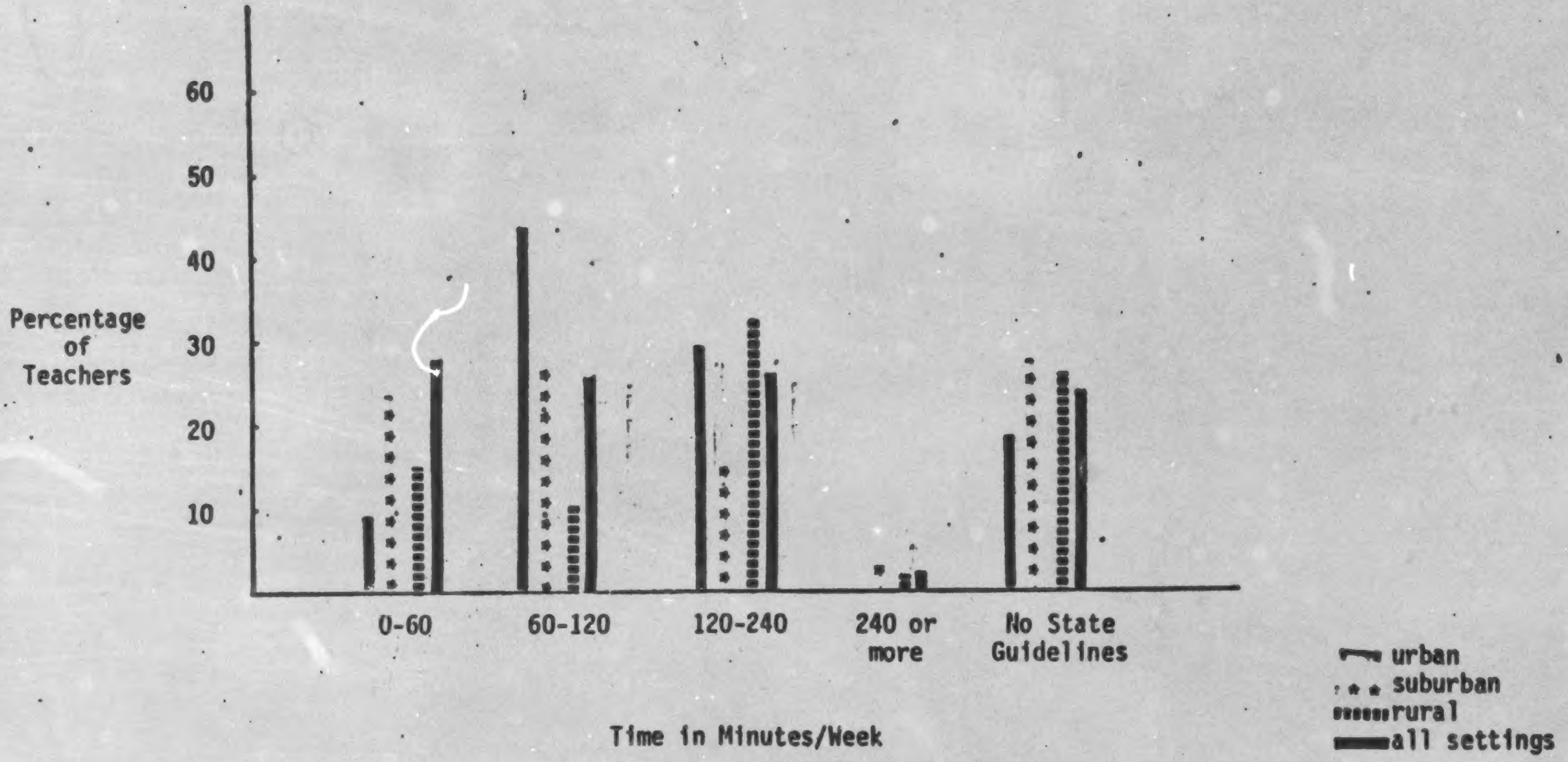

Figure 65. Time of instruction required by state guidelines as perceived by teachers according to residential setting.

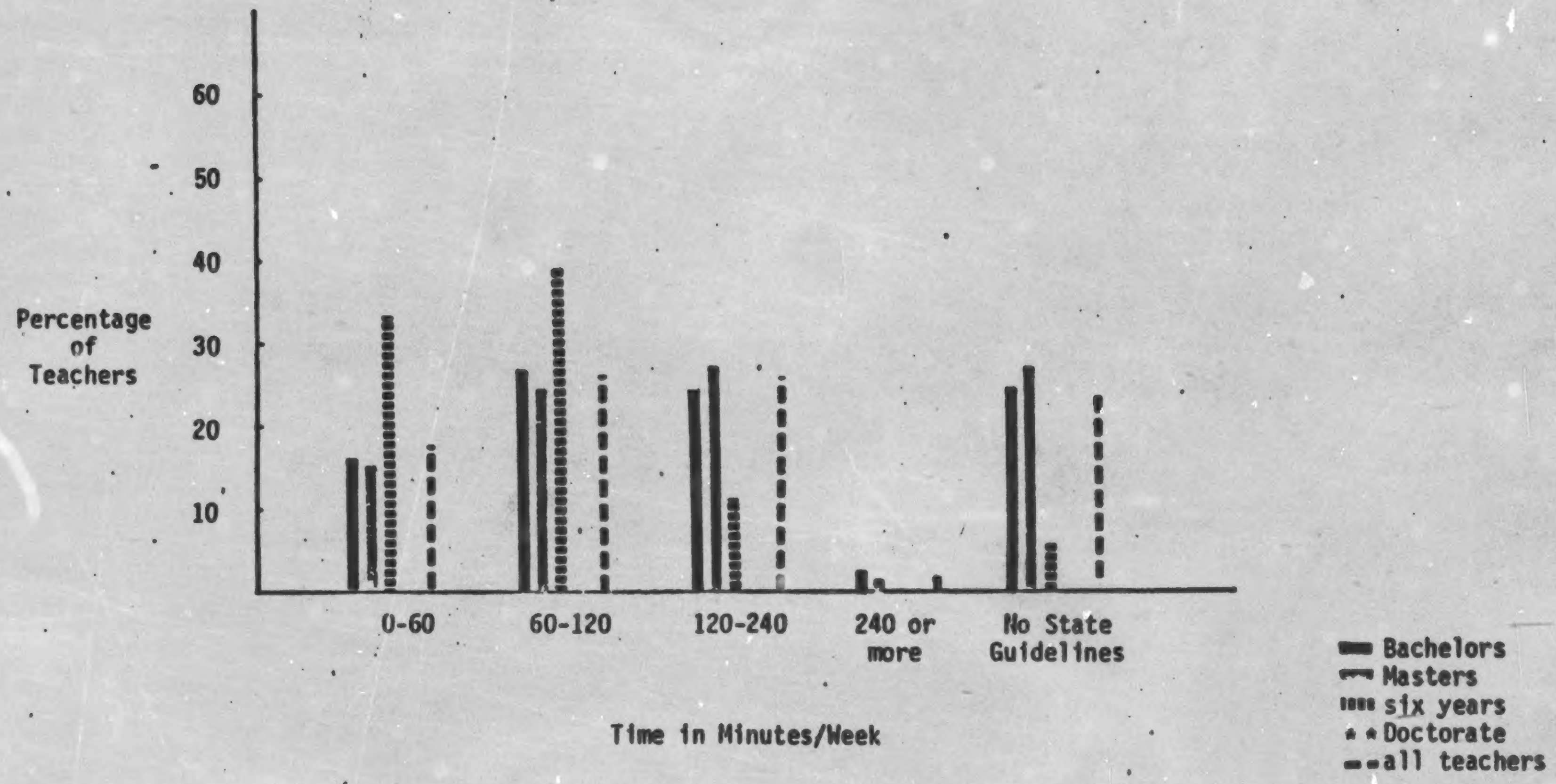

Figure 66. Time of instruction required by state guidelines as perceived by teachers according to teachers academic background.

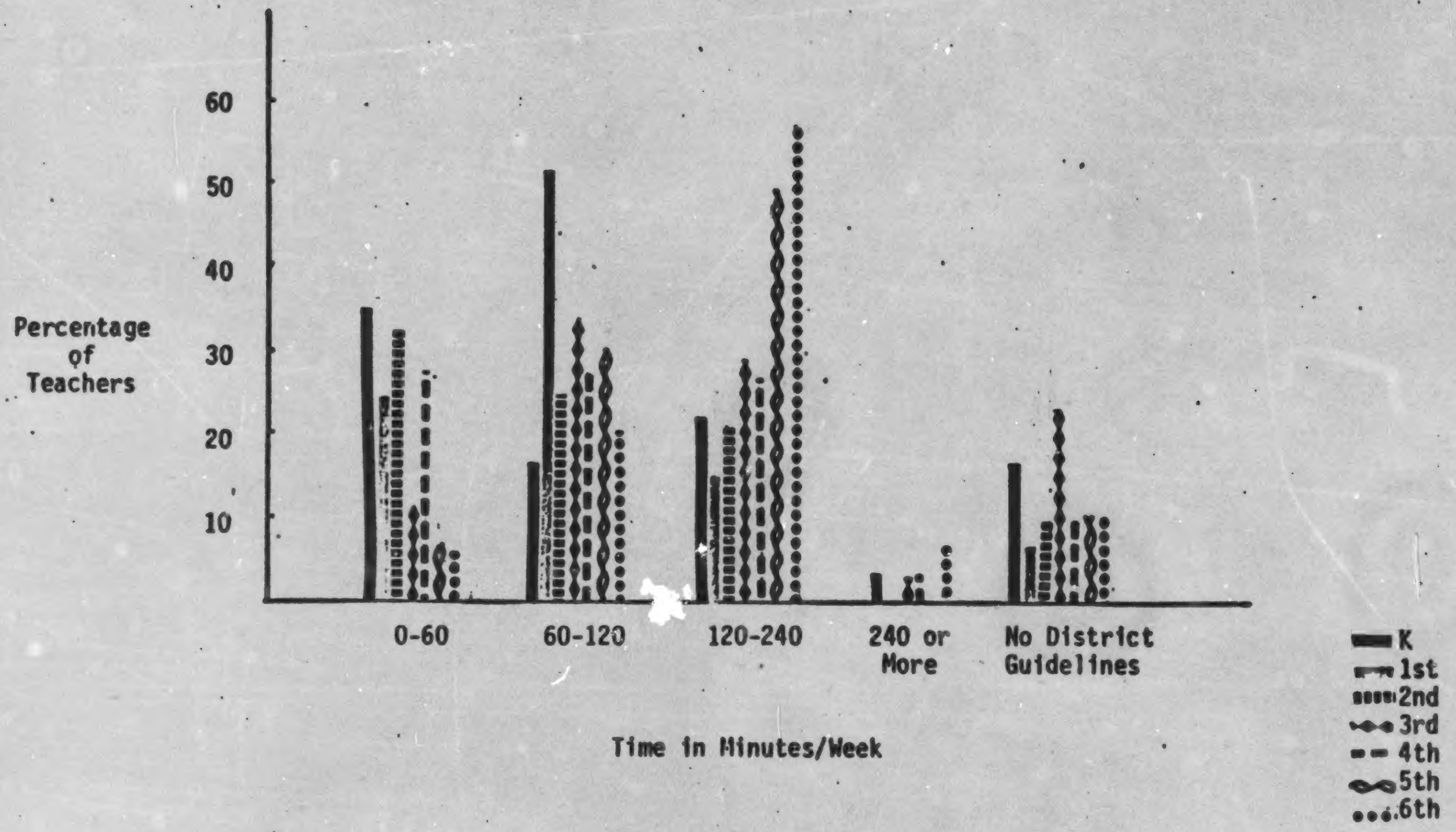

Figure 67. Time of instruction required or suggested by the school district as perceived by teachers according to grade.

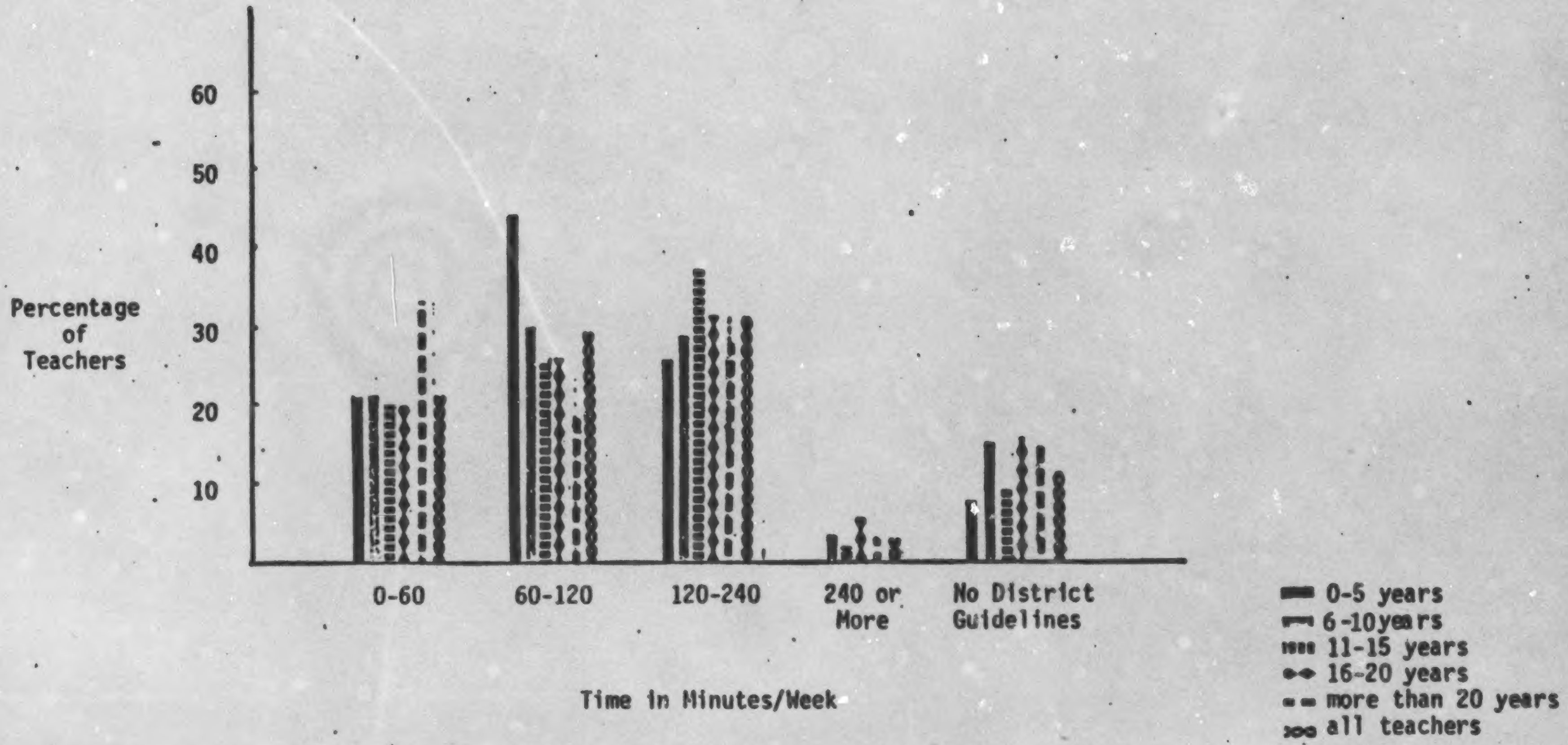

Figure 68. Time of instruction required or suggested by the school district as perceived by teachers according to years of experience.

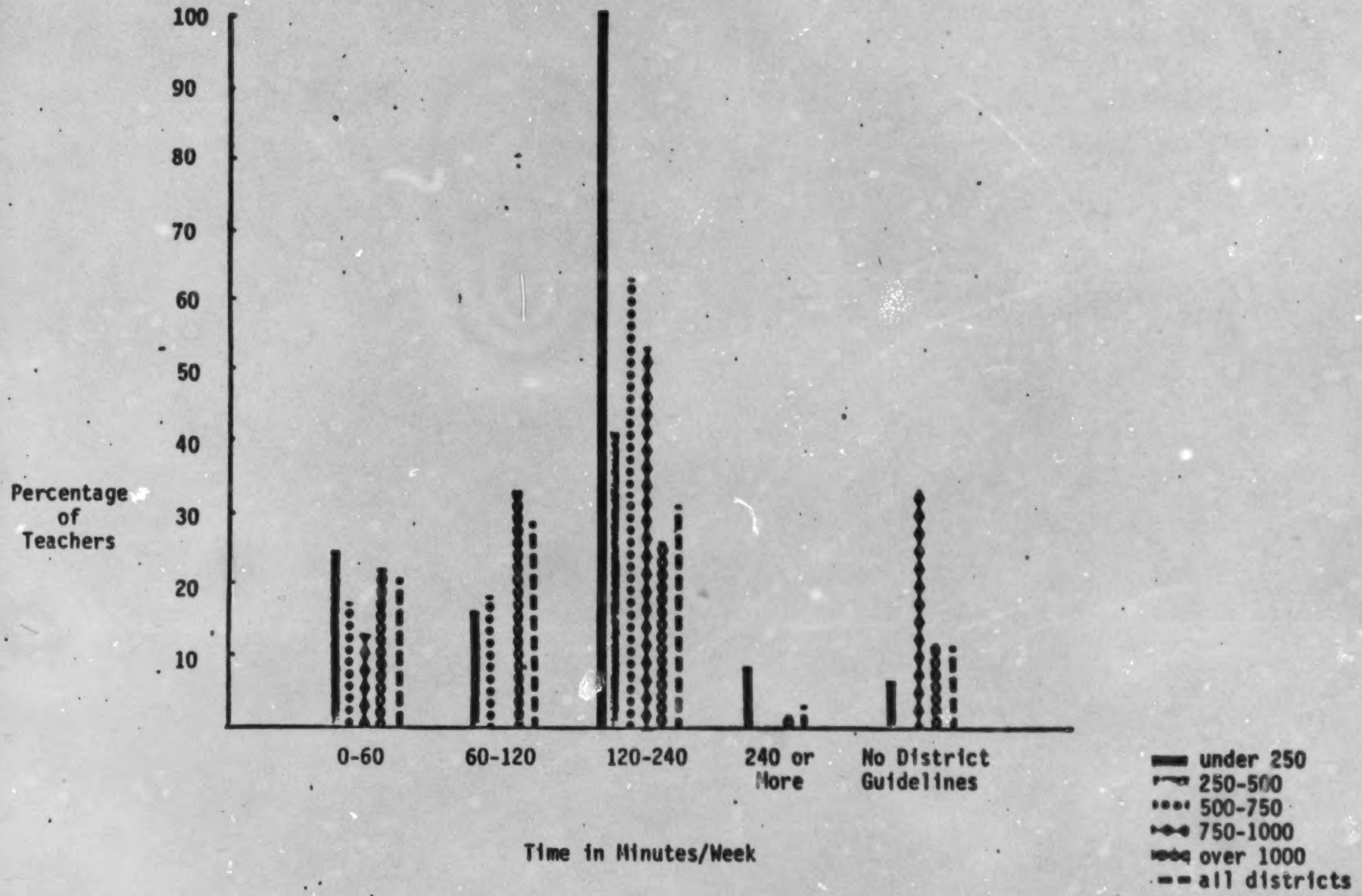

Figure 69. Time of instruction required or suggested by the school district as perceived by teachers according to school district size.

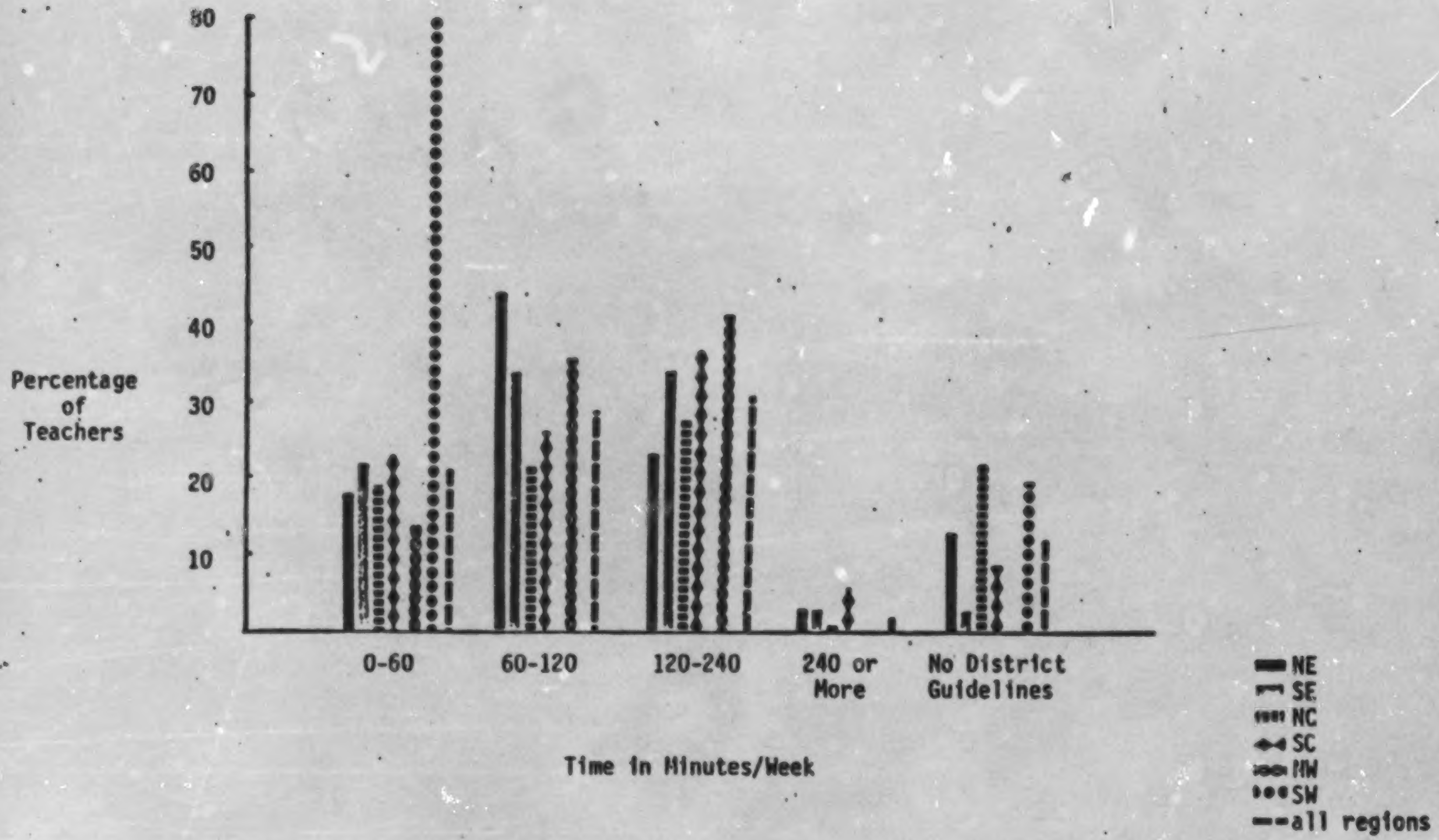

Figure 70. Time of instruction required or suggested by the school district as perceived by teachers according to geographic region in the U.S.

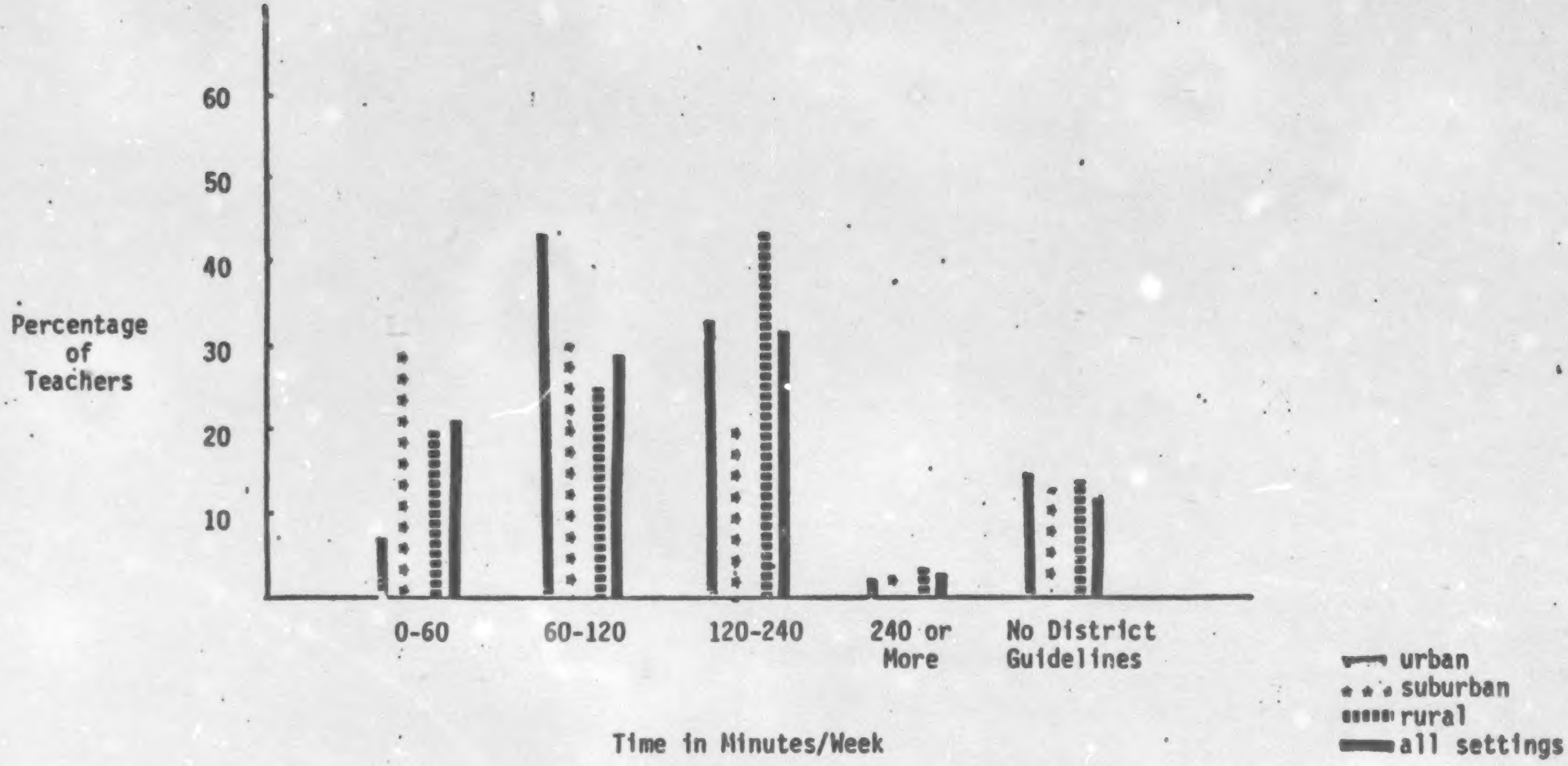

Figure 71. Time of instruction required or suggested by the school district as perceived by teachers according to residential setting.

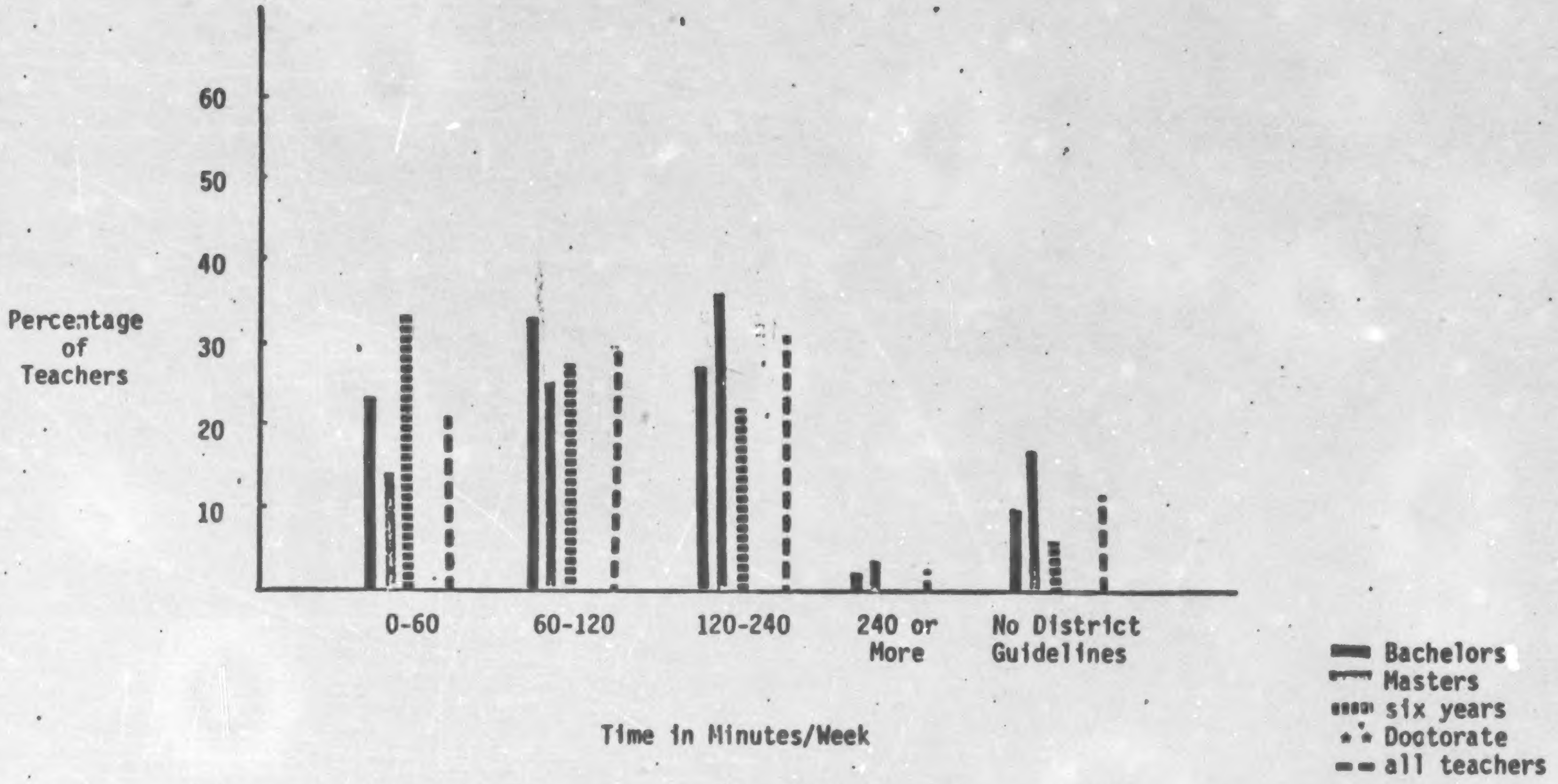

Figure 72. Time of instruction required or suggested by the school district as perceived by teachers according to teachers academic background.

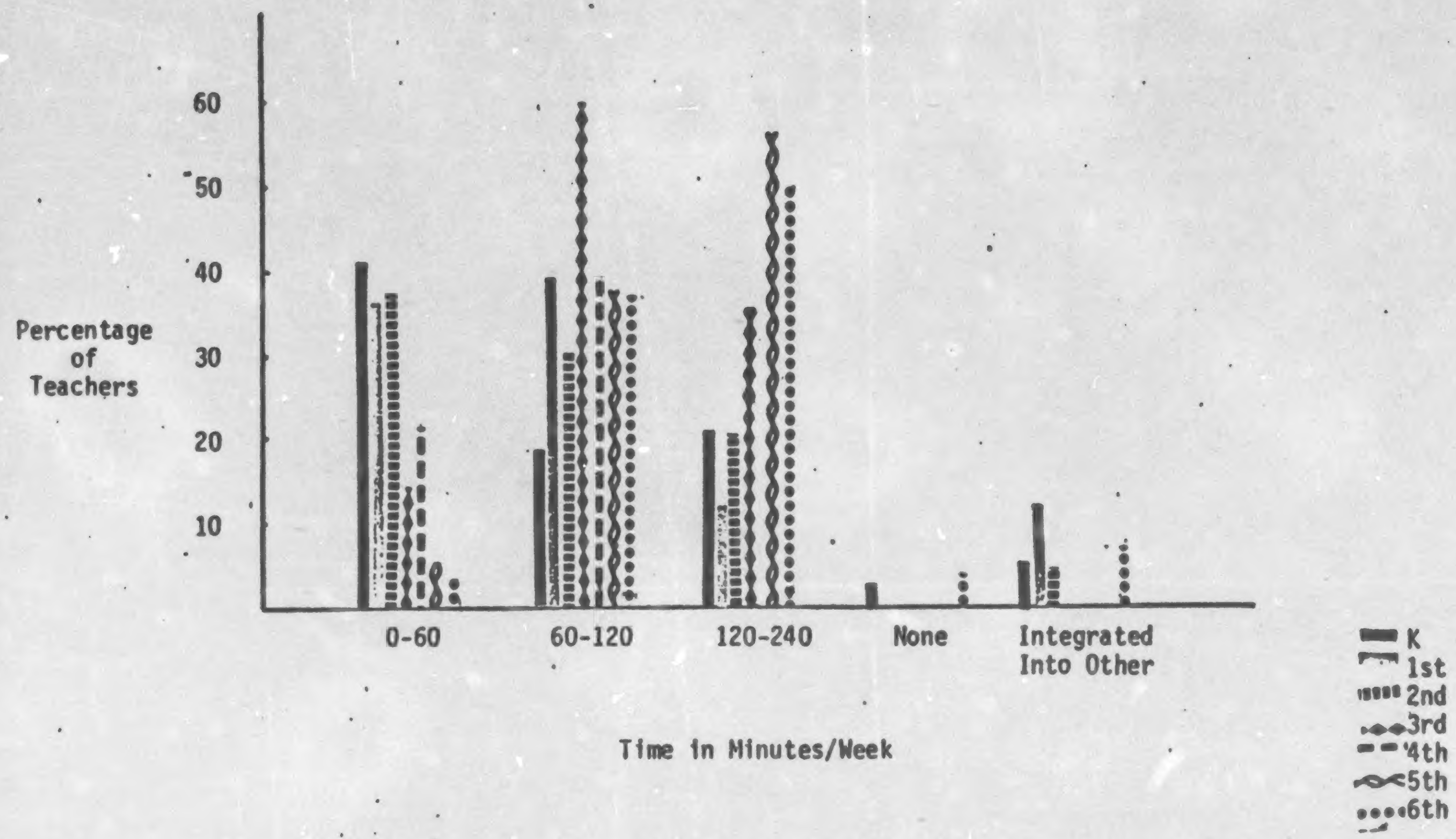

Figure 73. Average time of science instruction spent by teachers according to grade.

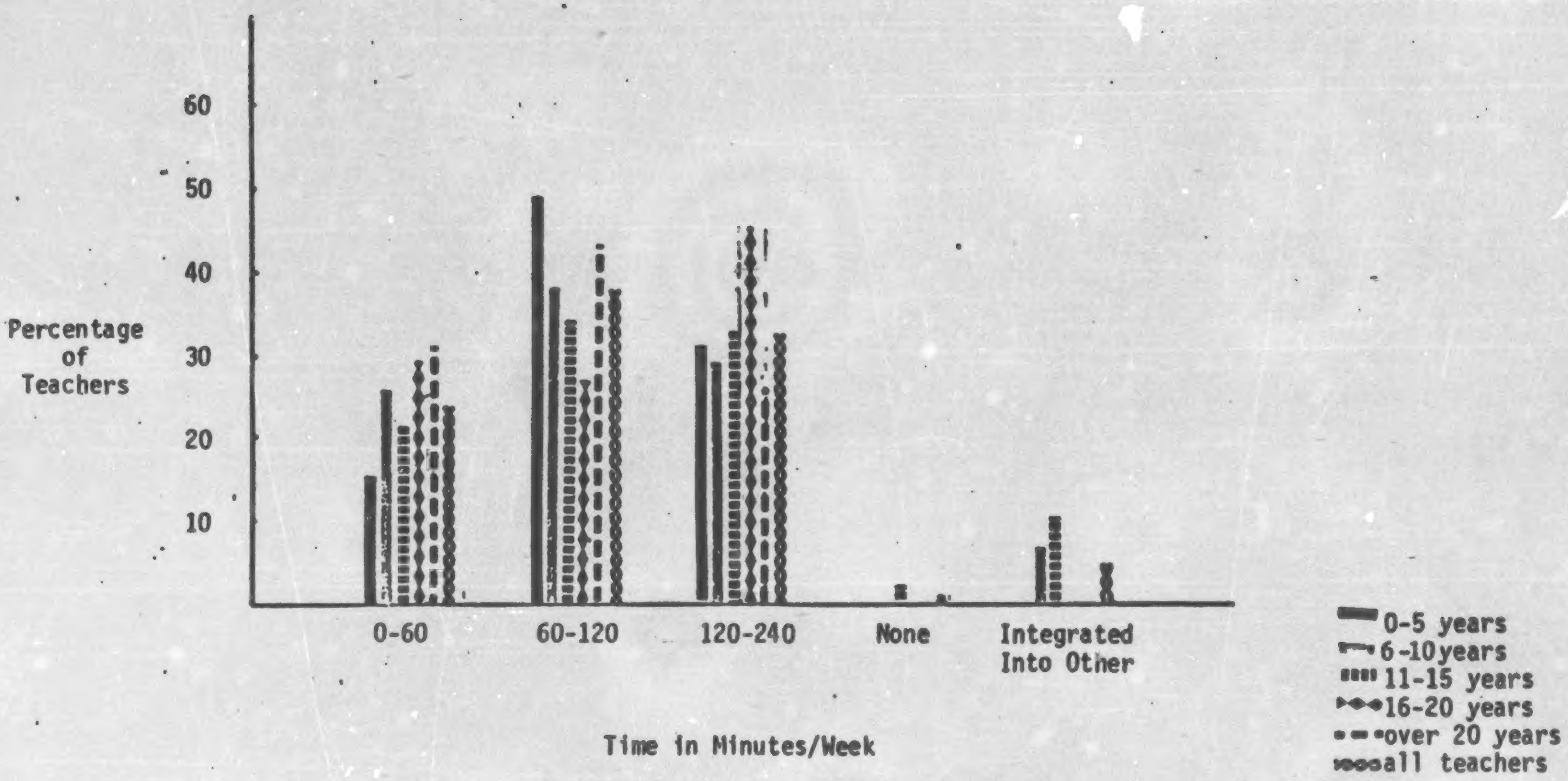

Figure 74. Average time of science instruction spent by teachers according to years of experience.

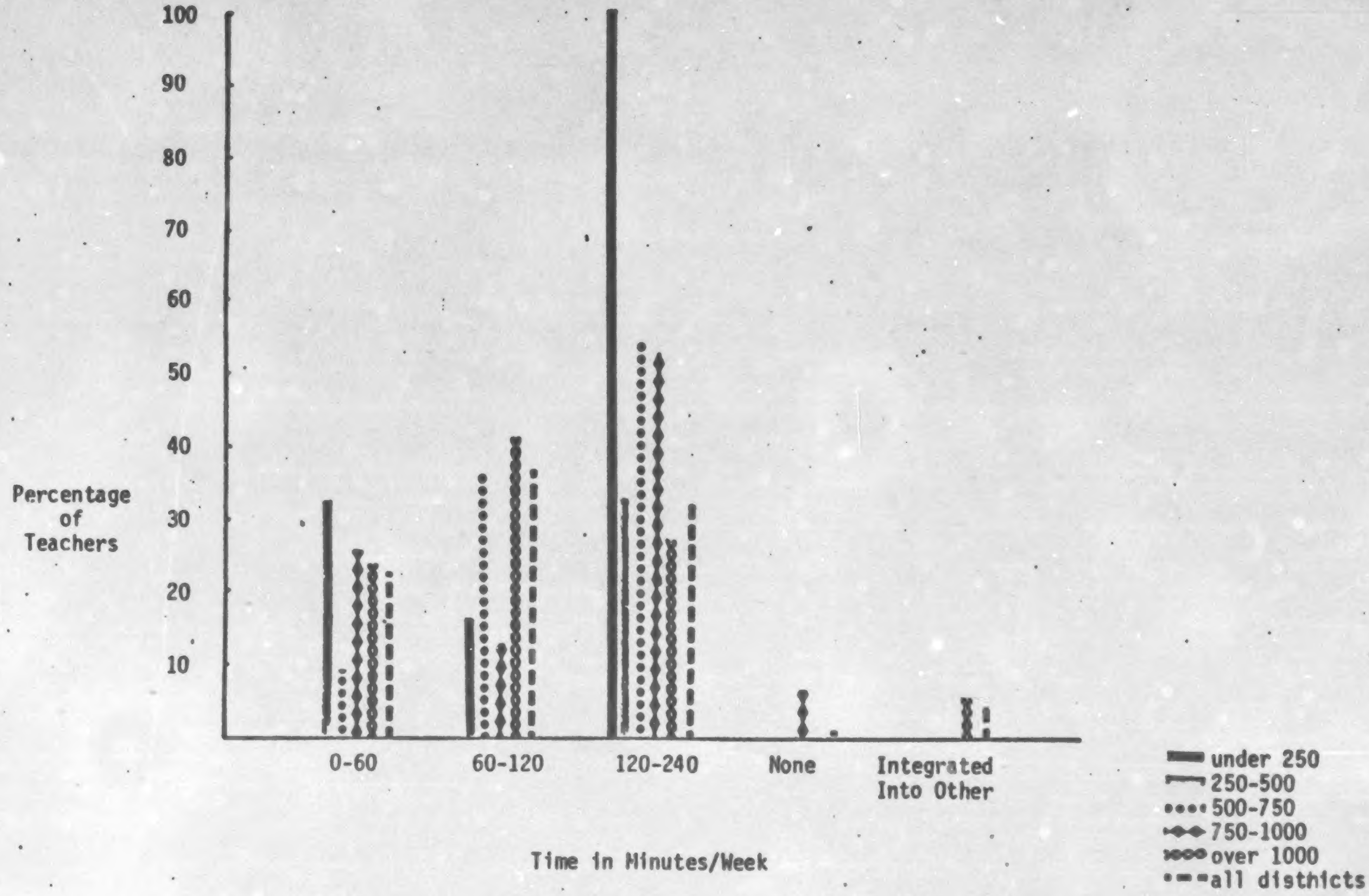

Figure 75. Average time of science instruction spent by teachers according to school district size.

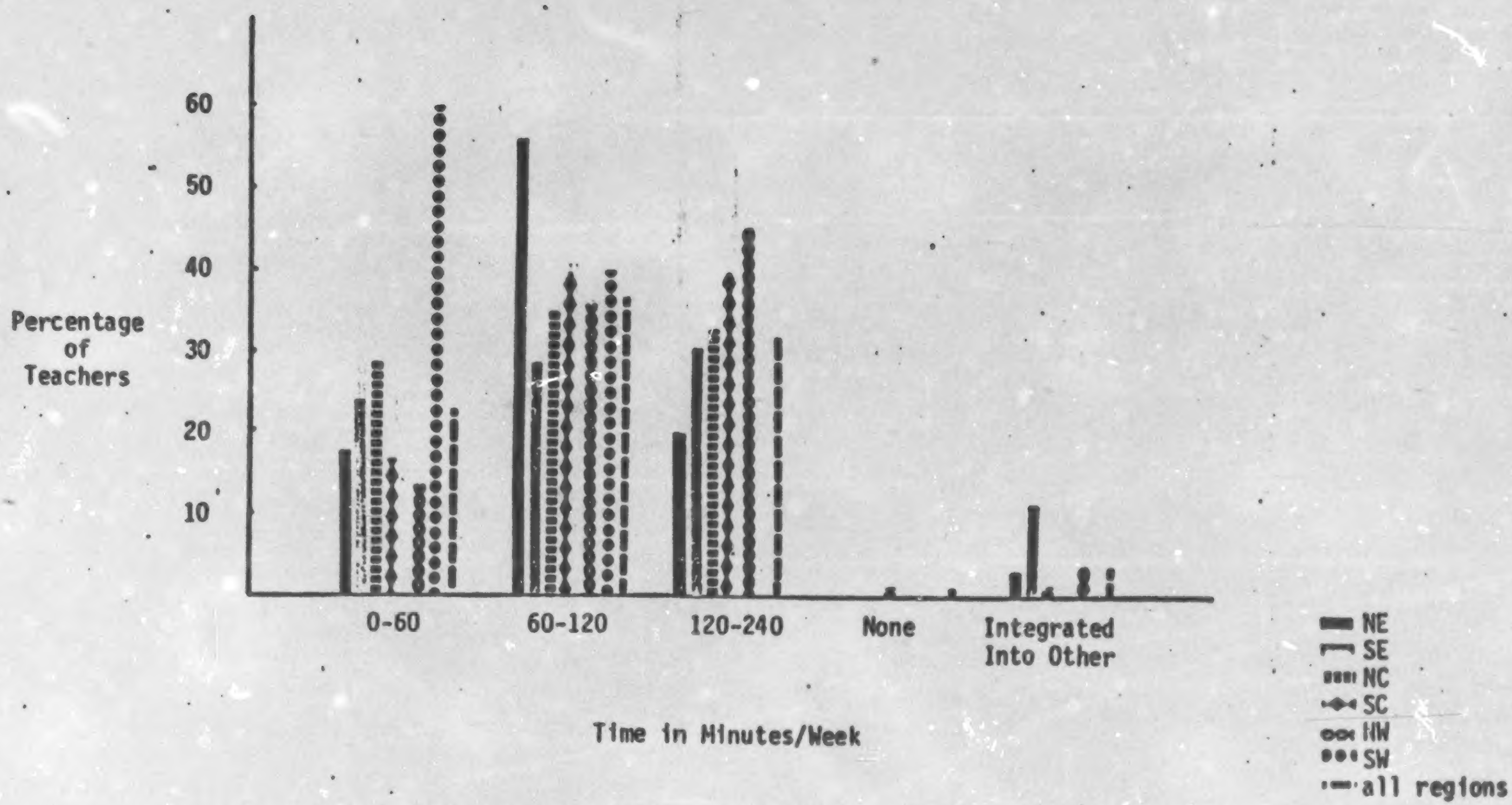

Figure 76. Average time of science instruction spent by teachers according to geographic region in the U.S.

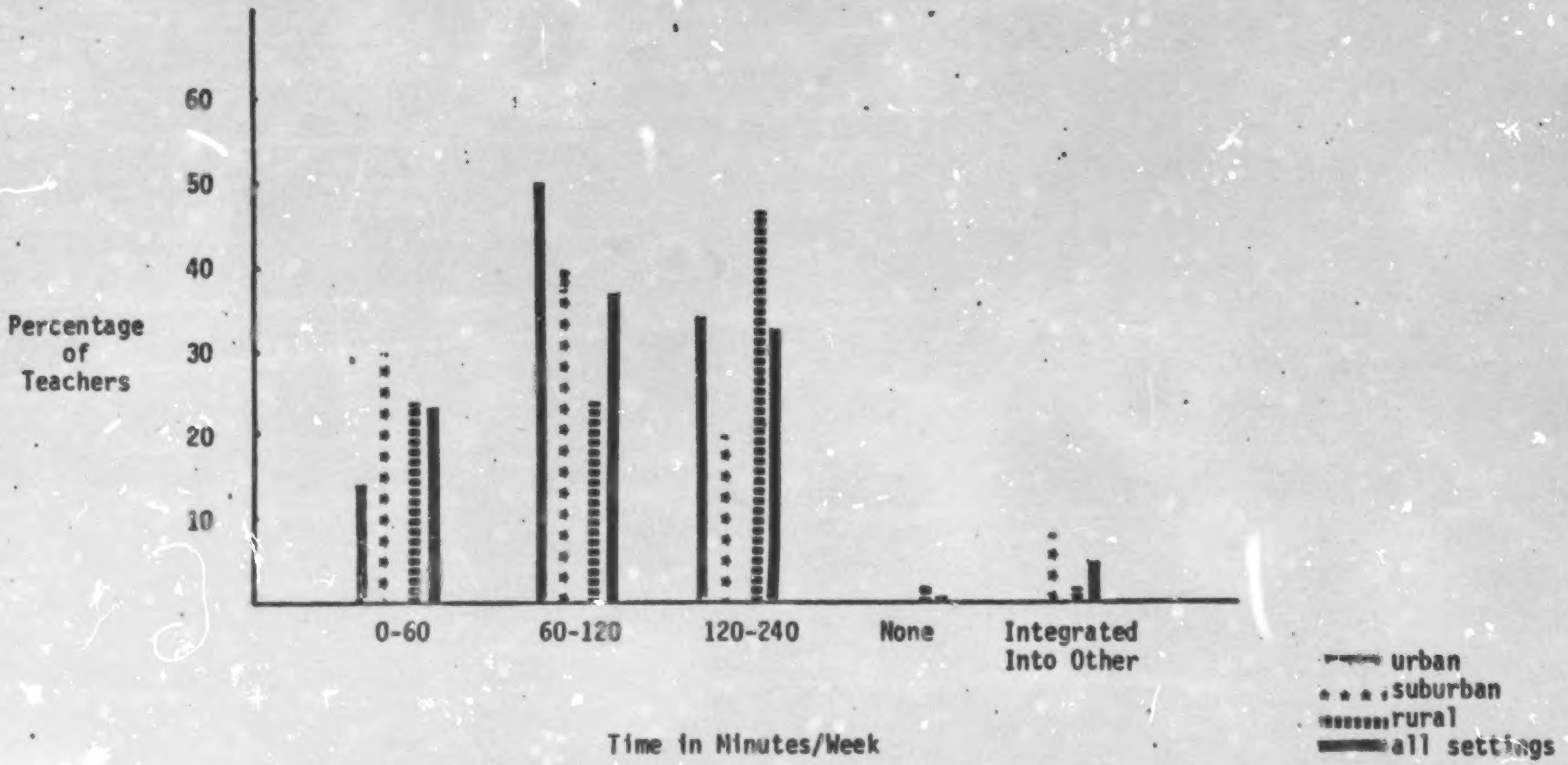

Figure 77. Average time of science instruction spent by teachers according to residential setting.

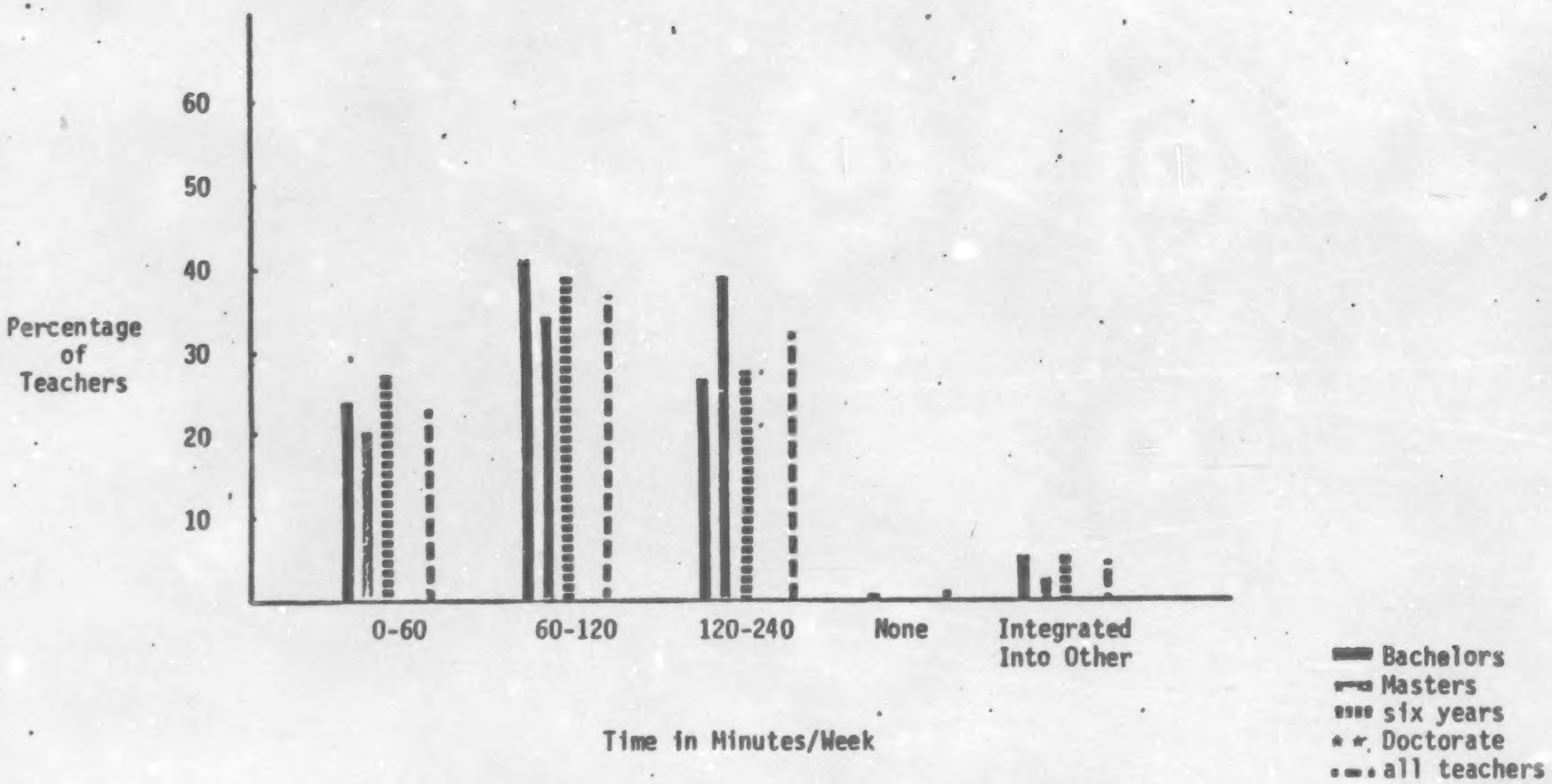

Figure 78. Average time of science instruction spent by teachers according to teachers academic background.

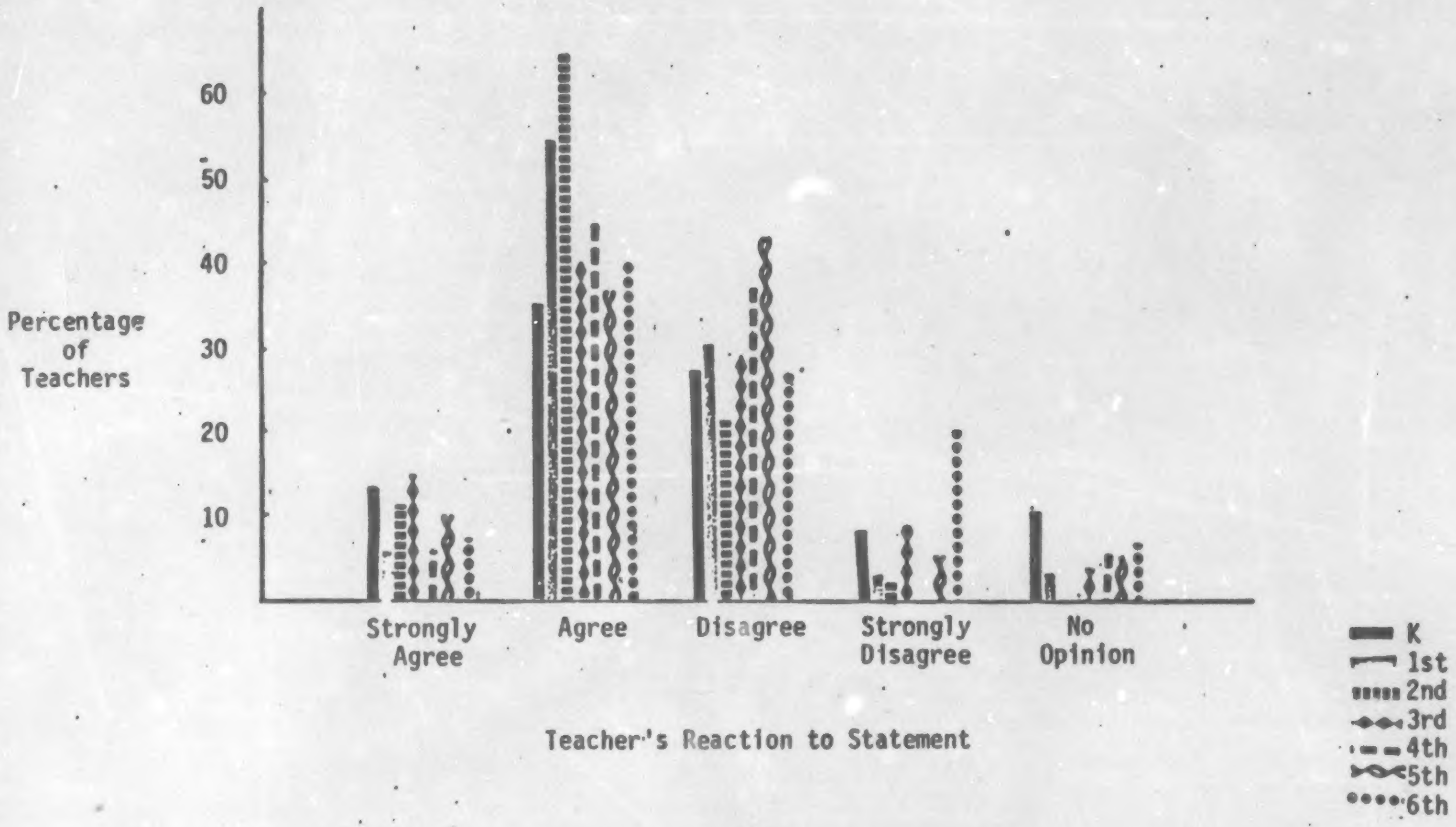

Figure 79. Teachers perceptions of the adequacy of science in their schools today according to grade.

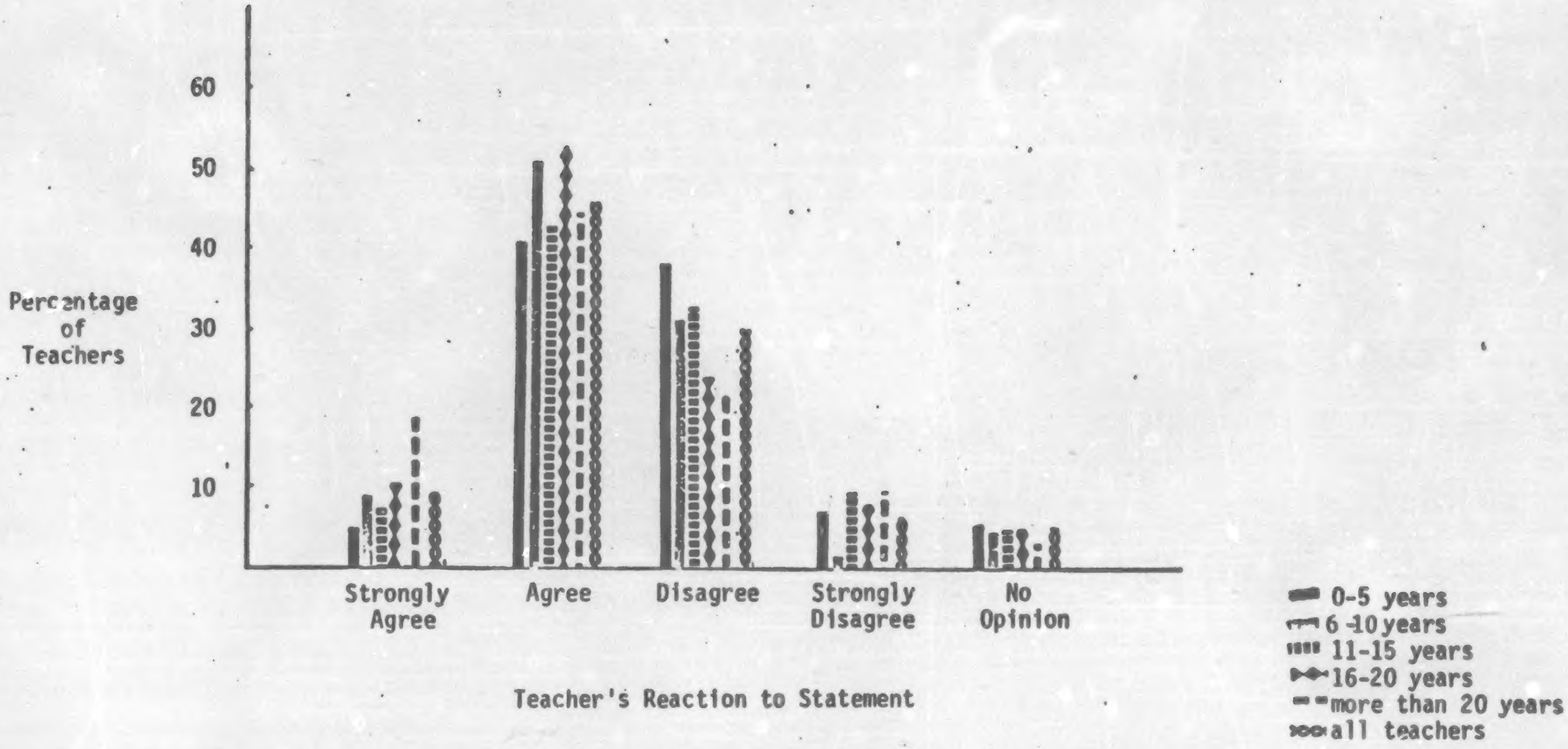

Figure 80. Teachers perceptions of the adequacy of science in their schools today according to years of experience.

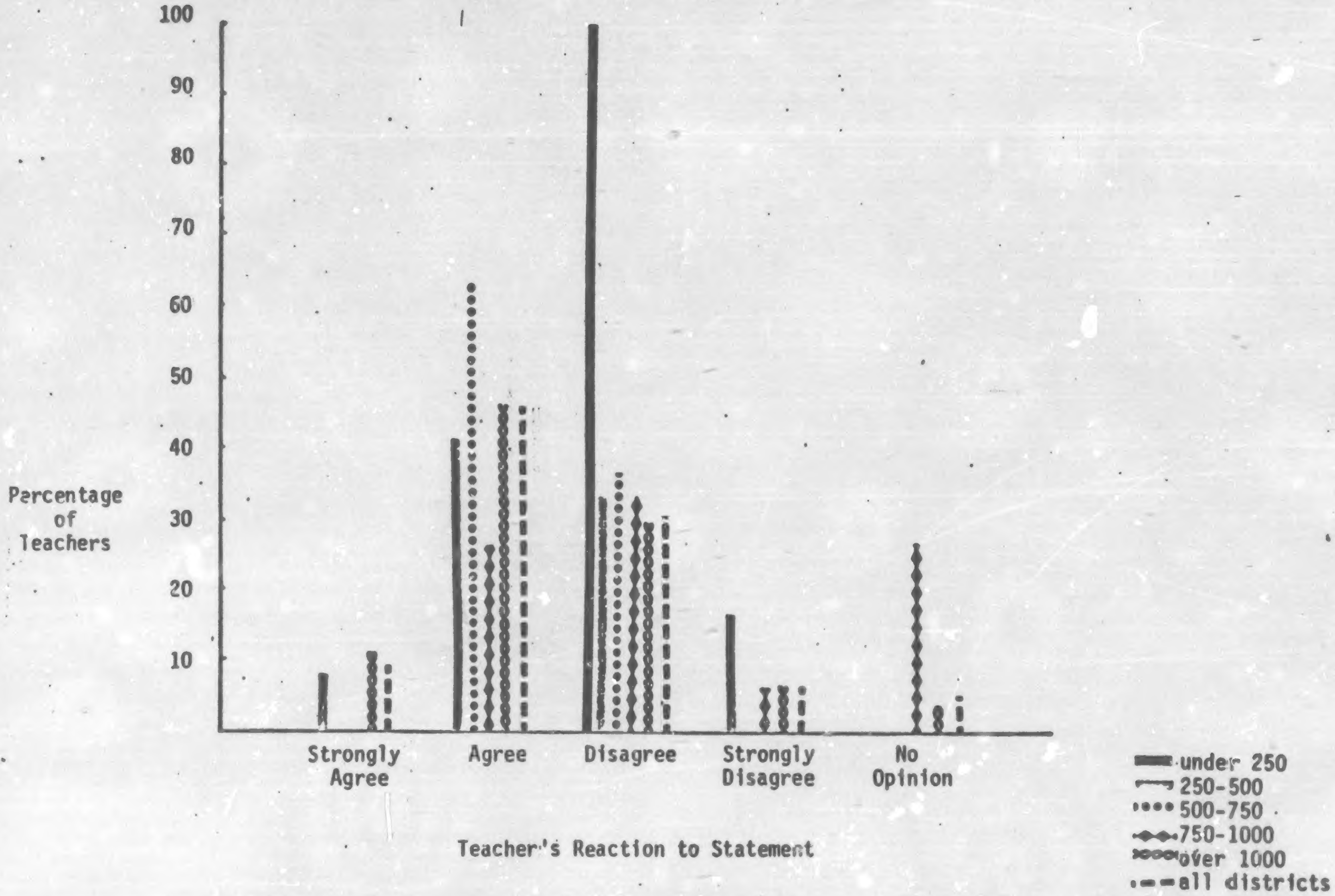

Figure 81. Teachers perceptions of the adequacy of science in their schools today according to school district size.

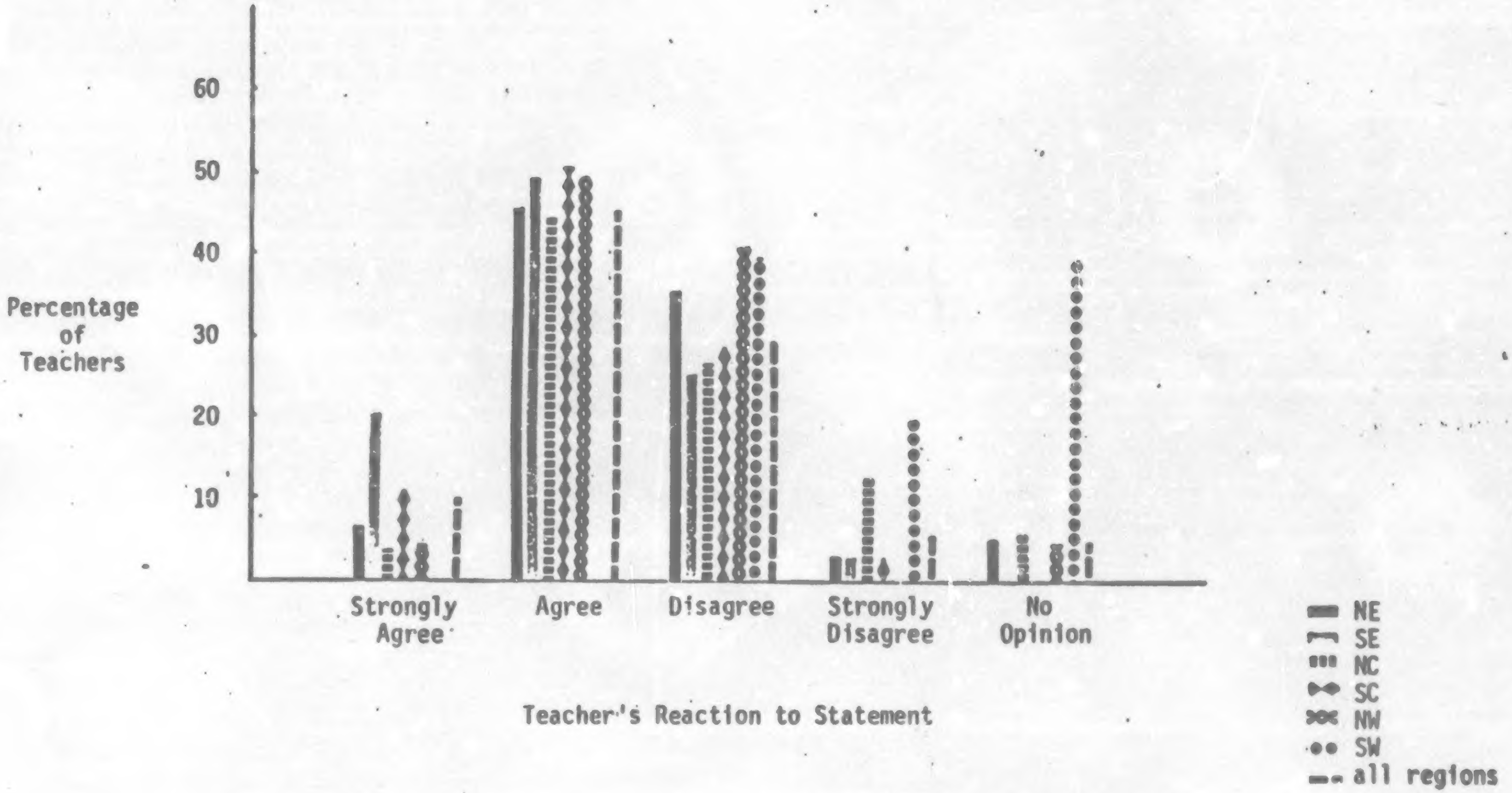

Figure 82. Teachers perceptions of the adequacy of science in their schools today according to geographic region in the U.S.

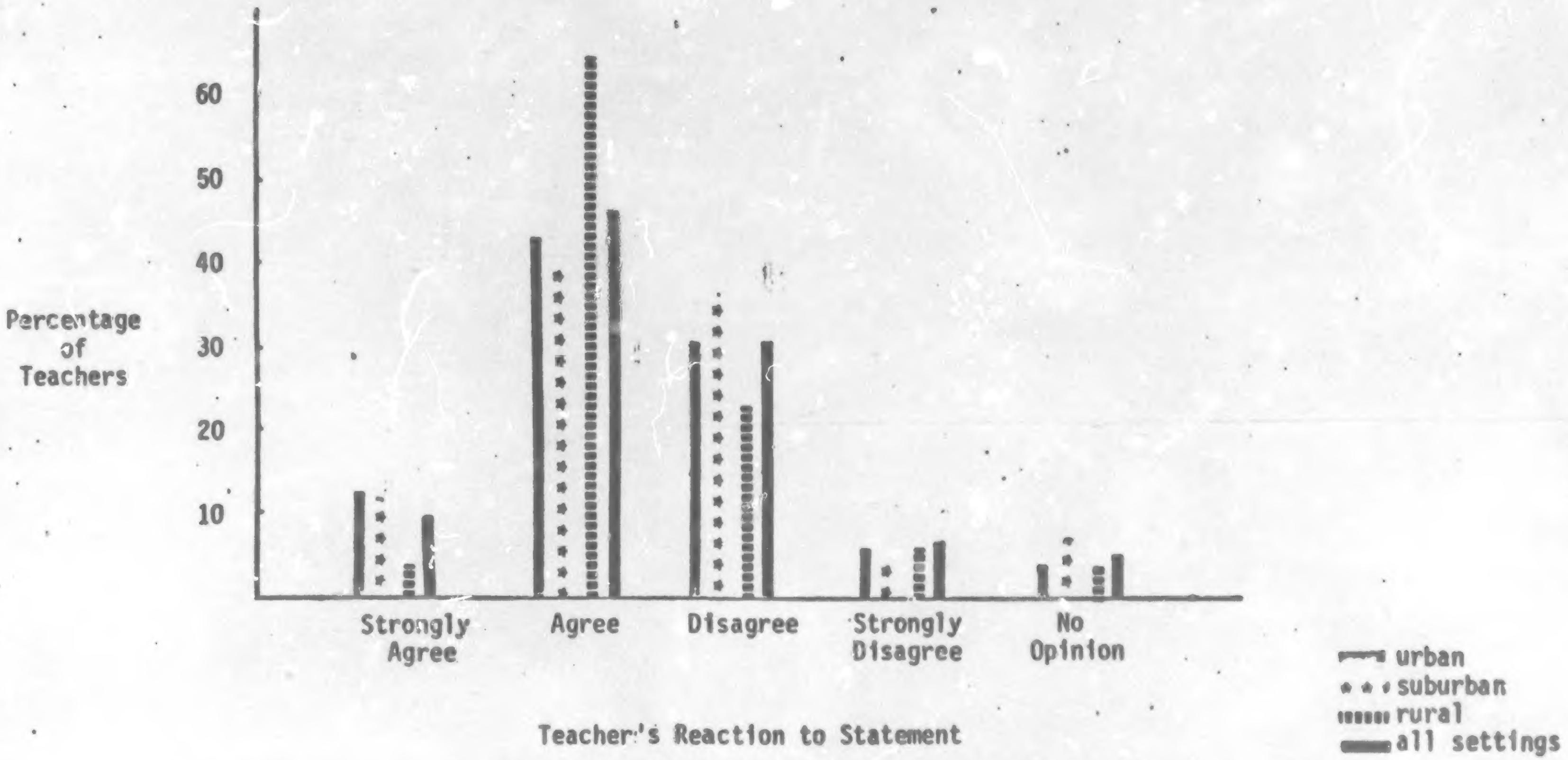

Figure 83. Teachers perceptions of the adequacy of science in their schools today according to residential setting.

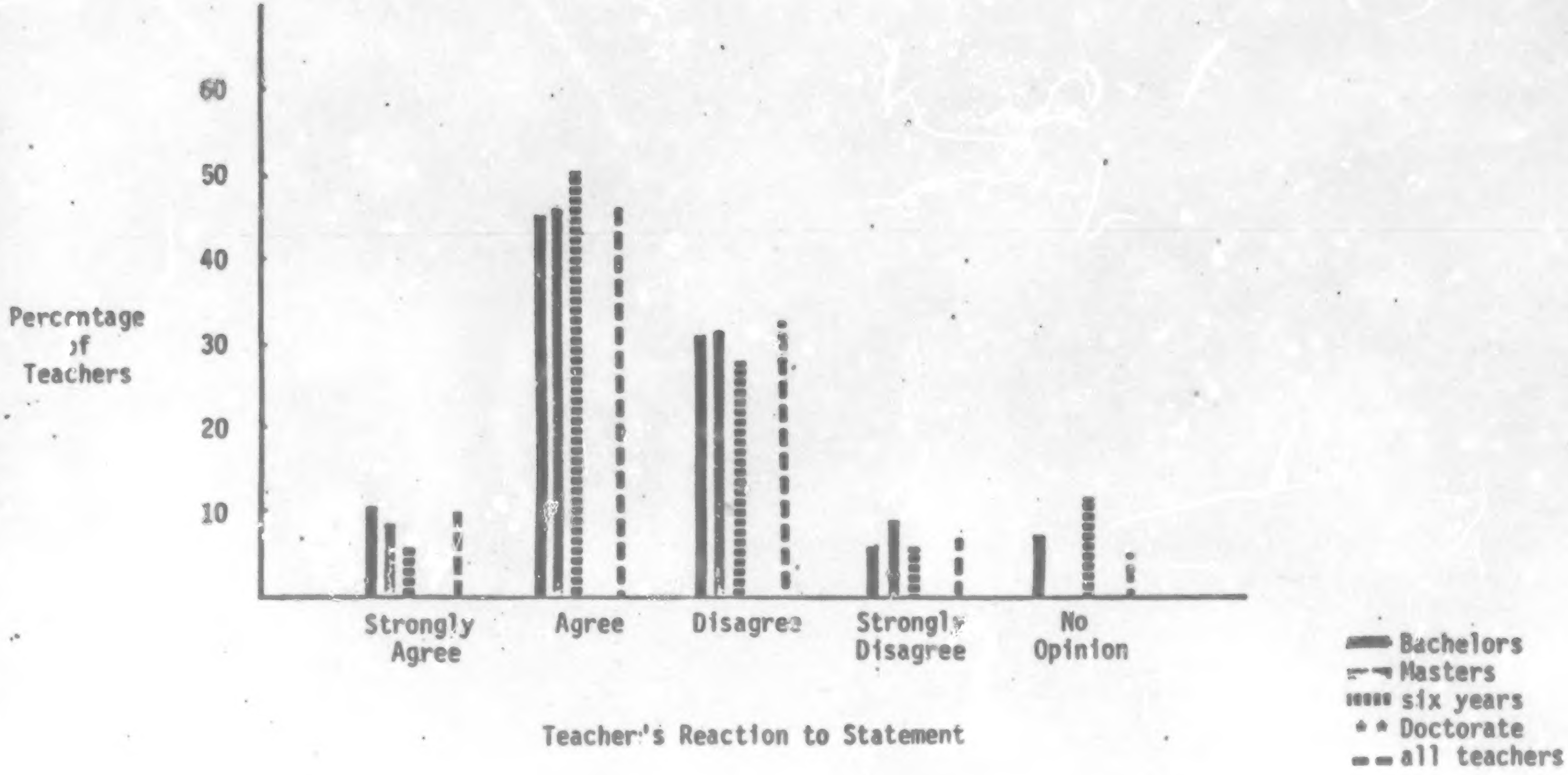

Figure 84. Teachers perceptions of the adequacy of science in their schools today according to teachers academic background.

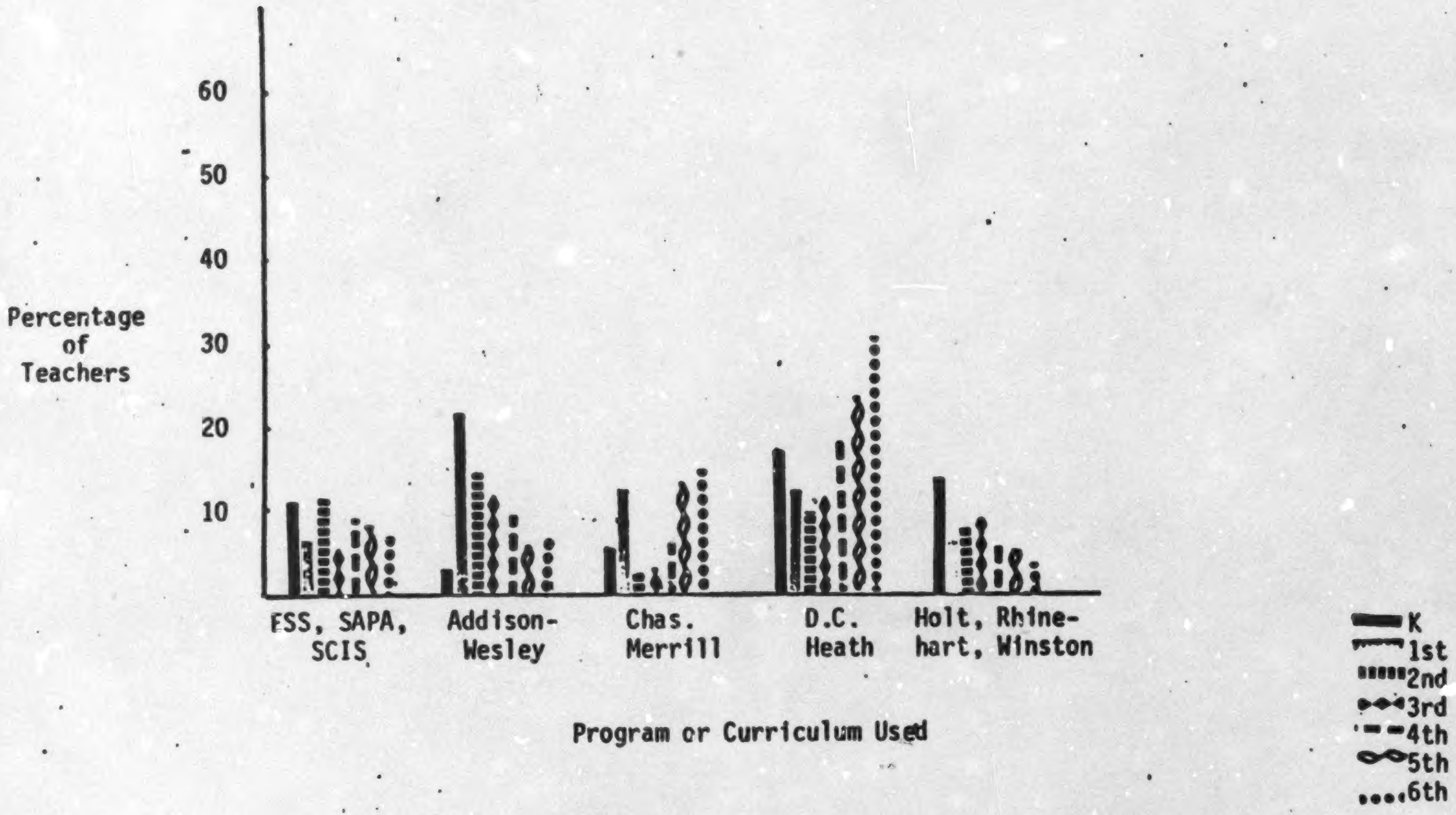

Figure 85. Elementary science programs currently being used by teachers according to grade.

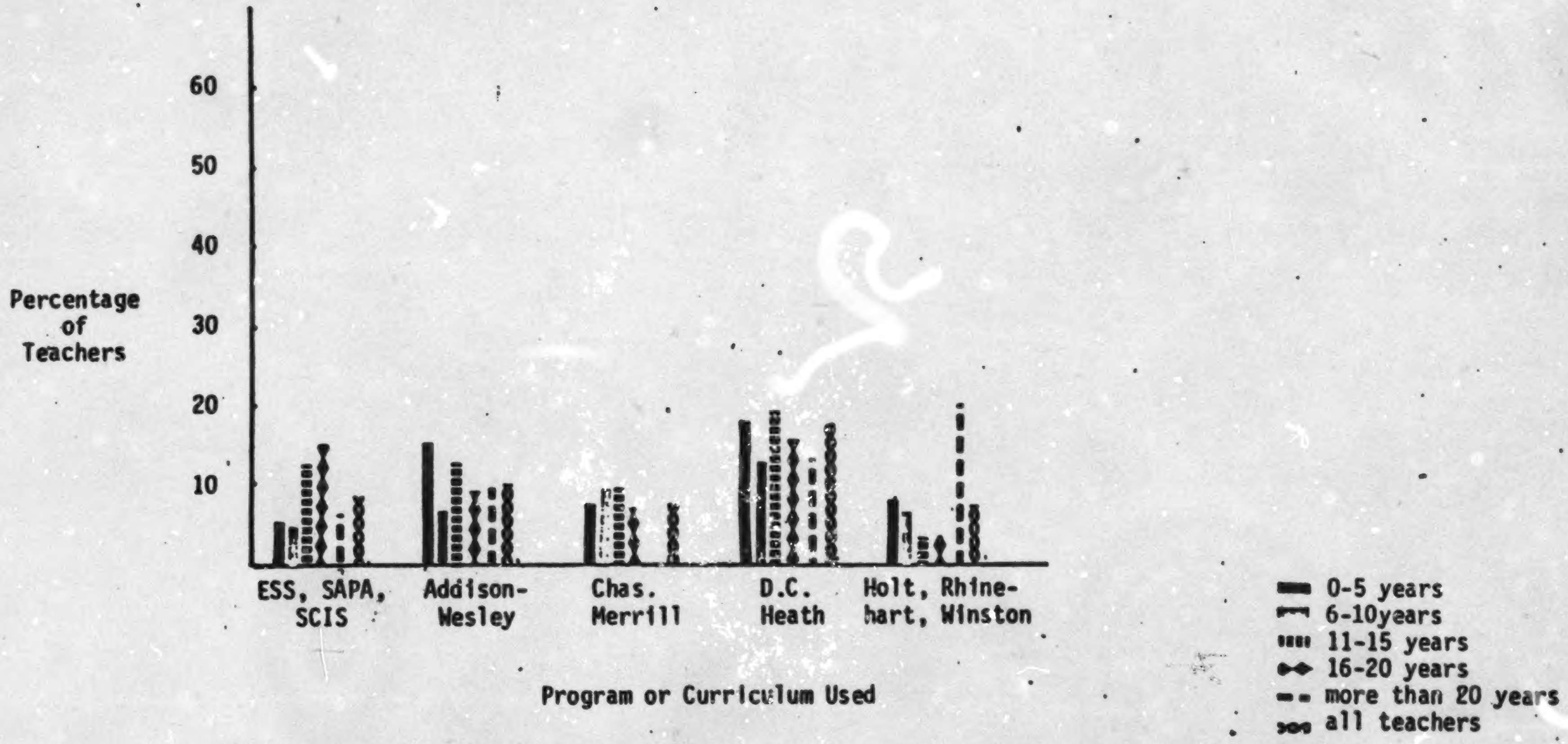

Figure 86. Elementary science programs currently being used by teachers according to years of experience.

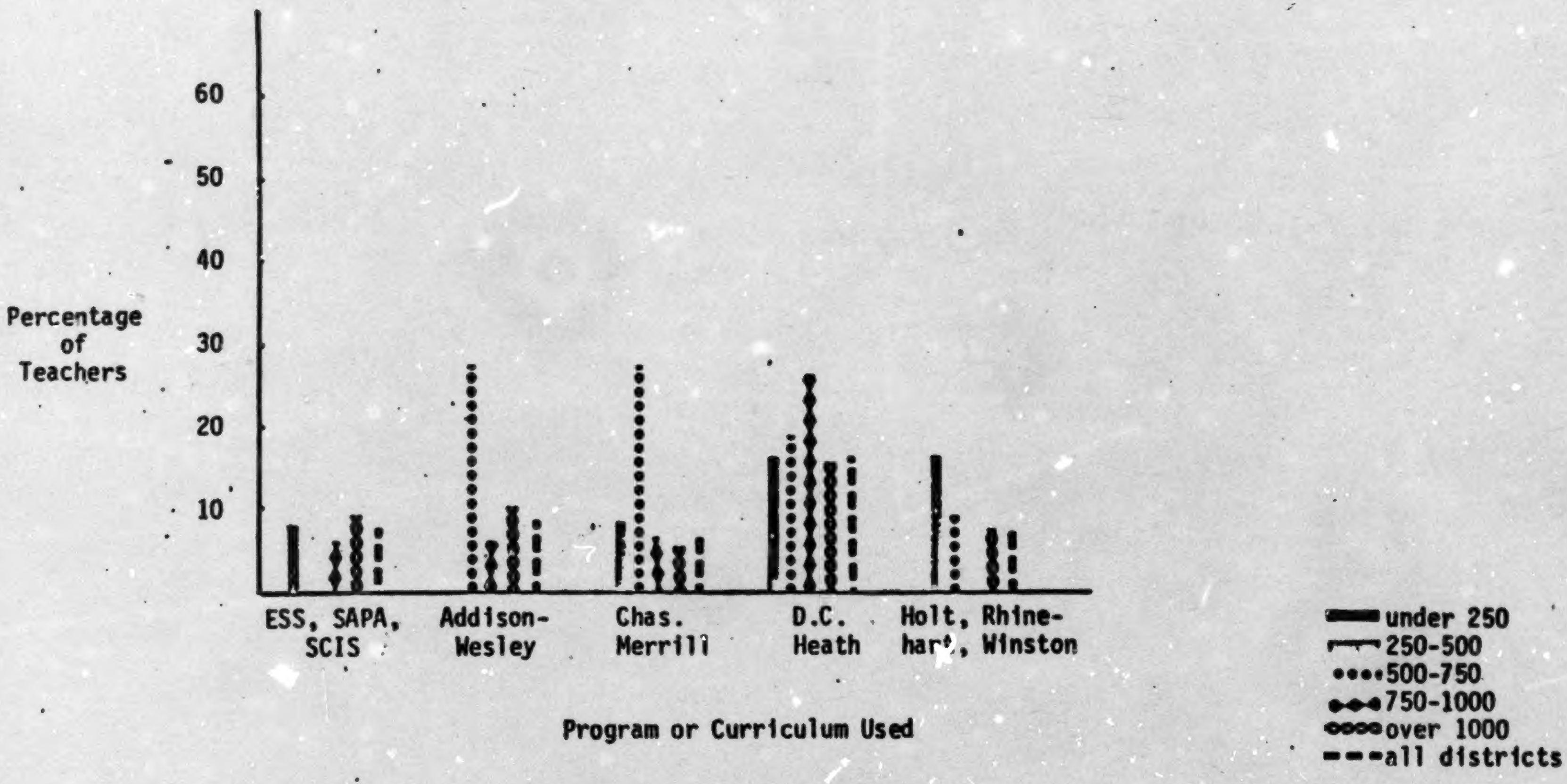

Figure 87. Elementary science programs currently being used by teachers according to school district size.

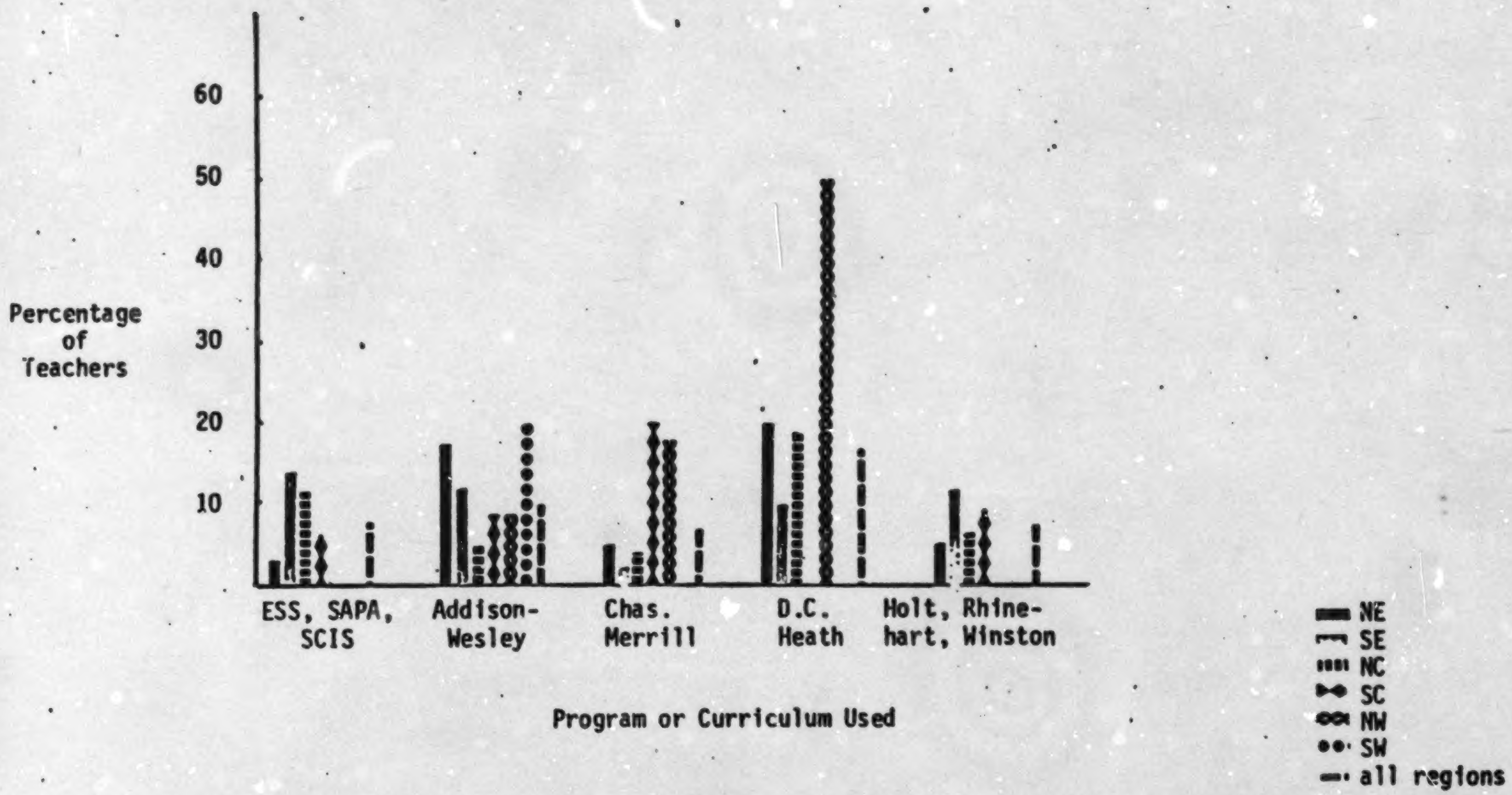

Figure 88. Elementary science programs currently being used by teachers according to geographic region in the U.S.

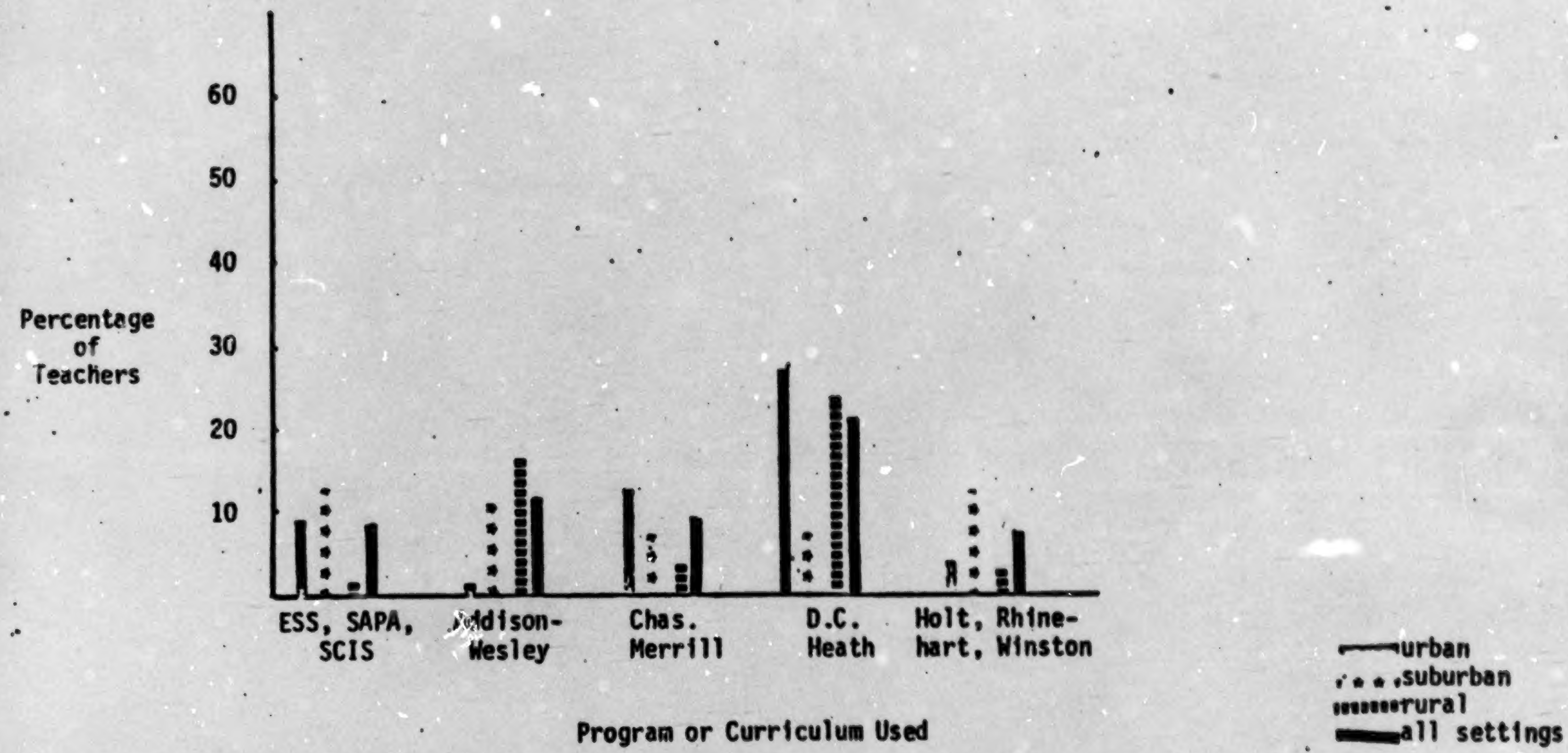

Figure 89. Elementary science programs currently being used by teachers according to residential setting.

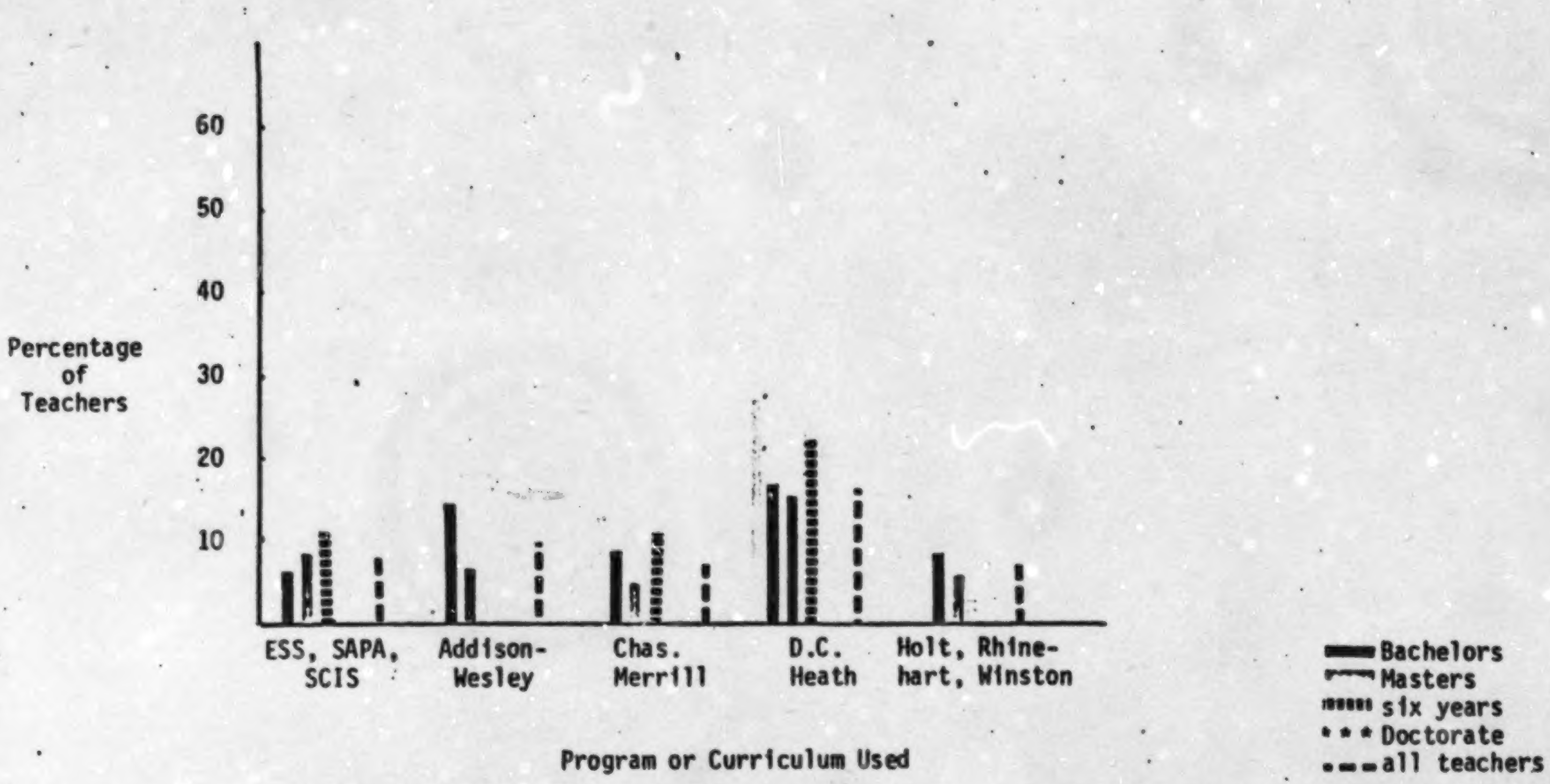

Figure 90. Elementary science programs currently being used by teachers according to teachers academic background.

APPENDICES

NATIONAL SCIENCE TEACHERS ASSOCIATION
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University of South Dakota, Vermillion

An Affiliate of the American
Association for the
Advancement of Science

April 28, 1983

Dear Principal:

The National Science Teachers Association is currently moving forward into the emphasis in education on "Science and Technology in Today Society".

The Pre School/Elementary Committee has designed a survey to identify the needs of elementary teachers. We are asking for your aid in accomplishing this task.

The National Association of Elementary School Principals has graciously provided NSTA with a cross section list of participants. The survey will be sent to over 100 elementary principals throughout the United States.

We hope that you will find that the survey is relevant and worthwhile. We are asking that you encourage ten elementary teachers in grades K-6, who are currently teaching elementary science, to participate in the survey. A cover letter is enclosed to explain the project to your teachers.

Also enclosed is a self-addressed envelope for your convenience in returning the survey to the computer center by May 15, 1983. Hopefully the survey results will be compiled by June 1, 1983. The results of the survey will be available upon request.

Thank you for your time and effort put forth in helping the committee complete this project.

Sincerely yours,

Peggy Teters

Peggy Teters
Pre School/Elementary
Division Director

PT/et

Peggy L. Teters
Elementary Teacher
Hickory Hills Elementary School
Springfield School District R-12
940 N. Jefferson
Springfield, MO 65802
(417) 864-3618

31st NSTA National Convention, Dallas, Texas, April 7-10, 1983

NATIONAL SCIENCE TEACHERS ASSOCIATION
1742 Connecticut Avenue, NW, Washington, DC 20009 (202) 328-5800

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Pontiac, MI Public Schools
Charles R. Estee, *SCST*
University of South Dakota, Vermillion

An Affiliate of the American
Association for the
Advancement of Science

April 28, 1983

Dear Colleague:

The National Science Teachers Association is working to develop resources to aid preschool/elementary teachers in science instruction. This can only be accomplished by teachers of these grade levels identifying their needs.

I would greatly appreciate your taking time (approx. 10 minutes) from your busy schedule to complete and return the enclosed questionnaire. It has been designed to assess your classroom needs. For your convenience a self-addressed envelope has been enclosed.

I would hope that our survey results would serve to reveal how science educators might better aid the work of teachers in schools and child care centers in their approach to science. Thank you for your time, consideration and interest.

Sincerely,

Peggy Teters

Peggy Teters
Pre School/Elementary
Division Director

PT/et

Peggy L. Teters
Elementary Teacher
Hickory Hills Elementary School
Springfield School District R-12
940 N. Jefferson
Springfield, MO 65802
(417) 864-3618

31st NSTA National Convention, Dallas, Texas, April 7-10, 1983

ELEMENTARY SCIENCE SURVEY OF THE NATIONAL SCIENCE TEACHERS ASSOCIATION

Thank you for taking time to complete this survey. The results of this national survey will be available through the NSTA Offices.

DIRECTIONS:

1. NAME - On the Answer Sheet, locate the NAME GRID and darken the appropriate bubbles in the order shown. A #2 pencil is required for all responses.

2. GENERAL INFORMATION - On the Answer Sheet, locate the SEX and DATE OF BIRTH areas and darken the appropriate bubbles.

   Next locate the NUMERIC GRID section. In Column #1 darken the bubble indicating the GRADE LEVEL you are currently teaching (0-Kindergarten; 1 = First; 2 = Second; etc.)

   In Column #2, darken the appropriate bubble for the span of YEARS OF EXPERIENCE, as listed below:
   1 = 0-5 yrs; 2= 6-10 yrs; 3= 11-15 yrs; 4 = 16-20 yrs; 5 = more than 20

   In Column #3, darken the appropriate bubble to indicate the SIZE OF SCHOOL DISTRICT in which you teach (K-12 enroll.), as listed below:
   1 = under 250; 2 = 250-500; 3= 500-750; 4= 750-1000; 5 = Over 1000

   In Column #4, darken the appropriate bubble to indicate the REGION OF THE U.S. you teach in, as listed below:
   1=Northeastern; 2=Southeastern; 3=North Central; 4=South Central
   5=Northwestern; 6=Southwestern.

   In Column #5, darken the appropriate bubble to indicate the TYPE OF RESIDENTIAL SETTING your district is located in, as listed below:
   1= Urban; 2 = Suburban; 3 = Rural.

   In Column #6, darken the appropriate bubble to indicate the COLLEGE DEGREE HELD, as listed below:
   1 = Bachelors; 2 = Masters; 3= Six Year Cert. (MA +36); 4 = Doctorate.

The following questions are to be answered in the TEST A & B areas of the Answer Sheet. When the choices appear in decimal form, the numbers to the RIGHT of the decimal point indicate the line # for the response (Example: Item 2.14 would indicate that the response will be entered on line #14 in the TEST A section of the Answer Sheet). The questions begin on the following page.

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1. Darken the appropriate bubble for each of the topics listed below which you teach at your grade level (A = Do Teach; B = Do Not Teach)

1.1 Charact. of vertebrates
1.2 Charact. of invertabrates
1.3 Charact. of plants
1.4 Growth and Reproduct.
1.5 Elements and Compounds
1.6 Geological changes
1.7 Stars and Constellations
1.8 Aerospace Exploration
1.9 Rocks, Minerals, Soil
1.10 Human Biology
1.11 Adaptation
1.12 Populations, Ecology
1.13 Life Cycles
1.14 Environmental Education
1.15 Energy
1.16 Sound
1.17 Light
1.18 Electricity
1.19 Simple Machines
1.20 Matter
1.21 Weather
1.22 Solar System
1.23 Oceanography
1.24 Fossils
1.25 Personal Hygiene
Others? Please identify ____________
____
____

2. On line #26, darken the appropriate bubble(s) to indicate which of the criteria listed below you feel are used to select the sequencing of the Science curriculum:
A. Publishers suggested
B. Student Interest
C. Scientific Process Skills
D. Learning Theory
E. Integration with Other Curricula
F. Other? ____________
____
____

3. One line #27, darken the appropriate bubble(s) to indicate which of the following groups are responsible to select content of the Science curriculum:
A. Policy Markers (Board, State)
B. Building Administrators
C. Science Curriculum Director
D. Science Committee
E. Individual Teacher Choice
F. Other? ____________
____
____

4. Beginning on line #28, darken the appropriate bubble(s) to indicate your choice of the THREE most commonly used methods of instruction used in your Science classroom (A = Do use; B= Do Not Use)
4.28 Textbook
4.29 Hands-On Activities
4.30 Multi-Media Presentation
4.31 Lecture
4.32 Small-Group Discussion
4.33 Large Group Discussion
4.34 Teacher Demonstration of Exp.
4.35 Computer Assisted Instruction
Other? ____________
____
____

5. Beginning on line #36, darken the appropriate bubble(s) to indicate those process-based national curriculum projects you have used in the last two years of instruction (A=Do Use: B = Do Not Use):
5.36 ESS
5.37 SAPA
5.38 SCIS
5.39 Other
5.40 None

6. Beginning on line #41, darken the appropriate bubble(s) to indicate the THREE factors you feel would be of the most help to you in improvement of your Science instruction (A = Helpful; B = Not Helpful):

6.41 Packaged Sci. Kits and TGs
6.42 Wrk. on Science Concepts
6.43 Wrk. on Org. Sci. Activities
6.44 Wrk. on Individualizing Sci.
6.45 Wrk. on use of Sci Equipment
6.46 Wrk. on Basic Skills thru Science
6.47 Wrk. on use current Sci. program
Other? ____________
____
____

7. Beginning on line #45, darken the appropriate bubble to indicate those areas listed below which hamper your Science planning/instruction (A=Does Hamper; B = Does Not Hamper):

7.45 Access to catalogs/journals
7.46 Avail. of library resources
7.47 Class size too large
7.48 Lab areas insufficient
7.49 Class ability range too wide
7.50 Lack of Science texts for students
7.51 Lack of supplies for hands-on act.
7.52 Insufficient planning/org. time
7.53 Poor curriculum guide
Others? ____________
____
____

8. On line #54, darken the appropriate bubble to indicate the amount of time of instruction (in minutes) required by STATE GUIDELINES PER WEEK:
A = 0-60
B = 60-120 min
C = 120-240 min
D = 240 or more
E = No State Guidelines

9. On line #55, darken the appropriate bubble to indicate the amount of TIME OF INSTRUCTION (in minutes) required/suggested by your SCHOOL DISTRICT PER WEEK:
A = 0-60 min
B = 60-120 min
C = 120-240 min
D = 240 or more minutes
E = No District Guidelines

10. On line #56, darken the appropriate bubble to indicate the amount of TIME OF INSTRUCTION (in minutes) YOU AVERAGE per week in Science Instruction:
A = 0-60 min
B = 60-120 min
C = 120-240 min
D = None
E = Integrated into other curricula areas

11. On line #57, darken the appropriate bubble to indicate your response to the statement, "Preschool/Elementary Science is being adequately taught in my school today,"
A = Strongly Agree
B = Agree
C = Disagree
D = Strongly Disagree
E = No Opinion

12. What elementary science program or curriculum are you currently using:
    A. Process-based: ESS, SAPA, SCIS
    B. Addison - Wesley
    C. Chas. Merrill
    D. D.C. Heath
    E. Holt, Rhinehart, Winston
    Other: ____________________
    ____
    ____

13. Comments? ____
____
____

Thank you again for your professional commitment in completing this survey. Good luck in your continuing efforts in Elementary Science education.

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